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# Performance Analysis of Events: Data Through March 31, 2010

J. Freeman

May 3, 2010

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## **Performance Analysis of Events: Data Through March 31, 2010**

**April 30, 2010**

**Contractor Assurance Office**



**LLNL-AR-430095**  
**By J. Freeman**

# Performance Analysis of Events

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# Performance Analysis of Events

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# **Performance Analysis of Events**

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# Performance Analysis of Events

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## 1.0 Summary

The Department of Energy (DOE) Manual 231.1-2, *Occurrence Reporting and Processing of Operations Information* requires a performance analysis of occurrence-based data to identify common elements that may present recurring problems. This report meets this requirement.

This report covers the analysis of 41 occurrences LLNL reported to DOE and LLNL's site-reportable data that occurred from 1 January through 31 December 2009 (CY09), with additional information presented for events through 31 March 2010, at LLNL's Site 200 (main site), Site 300 (test site), and at the Nevada Test Site (LLNV). It is notable that 30 of the 41 occurrences experienced in CY09 were reported in the first six months of CY09. The remaining 11 occurrences were reported in the last six months of the year. On the surface, this downturn in events reported to ORPS during the last six months of the year represents a significant change. It could indicate significantly improved performance, possible under-reporting or random variation of events. If this decreasing trend continued into 2010, then a thorough analysis of the causes would be warranted. This appears to be simply random variation in reporting.

This report analyzes occurrences looking for trends and recurring events. In Section 2, a comparison is made between LLNL and the rest of the DOE complex for the number of occurrence reports (ORs) filed and the reporting criteria groups and significance categories of the occurrences. LLNL ranked as the eighth highest site in terms of number of occurrences, out of all 40 DOE sites reporting occurrences in ORPS for CY09. The average number of occurrences reported for all 40 DOE sites is 29.6. Of the 25 sites with effort hours available, LLNL has the sixth highest effort hours for the reporting period. Effort hours and the number of occurrences are positively correlated between these 25 sites. LLNL's rate of occurrence, 0.69 occurrences per 100 full-time equivalent (FTE) workers, is well below the DOE median rate of 0.95, and below the overall average rate of 1.22 for the 25 sites.

In Section 3, both ORPS-reportable and Below-ORPS-reportable events are analyzed to look for recurring occurrences. Site-reportable (SR) events or conditions are below the DOE reporting criteria threshold, however, they are analyzed for potential recurring problems. The occurrence reports are grouped and analyzed by several different methods. The occurrences are examined by reporting criteria group, causal code(s) and grouped by Principle Directorates (PD).

Section 4 discusses recurring patterns and analyses of occurrence events.

Section 5 discusses the disposition of items that had been placed on the "Watch List" in previous reports. Three below-ORPS groups are on the Watch List for the next report:

Section 6 discusses special reports and/or assessments that were conducted by LLNL or others that have or may have implications for occurrences onsite.

Section 7 describes recent occurrences and the timeliness of occurrence reporting.

In summary, the analysis of the data indicates that there is a recurring condition in the area of unsafe vehicle operations, and a recurring occurrence report is being prepared.

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Also, three of the Below-ORPS reporting criteria will be on the Watch List for the next report: Group 2A – Personal Safety (injuries/illness); Group 4C – Facility Status (violations of safety controls in procedures, etc.); Group 5 Environmental (unauthorized or accidental releases to the environment).

There were two Operational Emergencies that did not share common causes and a vehicle fatality in June 2009. A DOE Type accident investigation was conducted for the event – the board concluded that the cause was a combination of vehicle safety features not used by the LLNL employee and his unfamiliarity with the operation of the vehicle. The judgments of Need (JONs) include: improvement of the driving behavior of the workforce; improvement in the selection process for general-use vehicles; workforce familiarity with fleet vehicle safety features; and effective accident scene management. A formal corrective action plan was approved by DOE for the JONs identified in the report. In February 2010, a worker inadvertently released the parking brake of a vehicle at Site 300, causing it to roll several feet before it was stopped by applying the parking brake from outside the vehicle. This event and the June 2009 vehicle fatality event share similar causes and represent a recurring condition. They are discussed further in the report.

There were 17 occurrences that required reporting to ORPS after 31 December 2009. Of these events, 10 were categorized as SC 3 events. They included unintended machining of a beryllium part; energized conductor cut without proper energy isolation, deep vein thrombosis from extended business travel, rolling truck near miss, personal air monitoring sample above the TLV for silica dust, slightly radioactive meters sent offsite for repair, leg fracture while riding a Lab bicycle, safety basis violation in B332, and drilling into a pressurized gas cylinder with hand drill. Eight events were categorized as Significance Category (SC) 4 events – they included suspect/counterfeit items, energy savings performance contract deficiencies, a high dosimeter reading; work control management concerns, activation of a B332 legacy alarm system and violations found during a recent CUPA inspections at Site 300.

Overall, the frequency of reporting occurrences is less than those listed in past reports. The distribution percentage among the directorates is similar to past reports, with slight variations as mentioned in Section 7, “Conclusions.”



## 2.0 Number and Types of Occurrences Reported

The number and types of occurrences that LLNL reports to DOE varies over time. This variation can be attributed to normally occurring changes in frequency; DOE's or LLNL's heightened interest in a particular subject area, changes in LLNL processes, or emerging problems. Since all of the DOE sites use the same reporting criteria, it is helpful to understand if LLNL is consistent with or diverging from reporting at other sites. This section compares the normalized number of occurrences reported by LLNL and other DOE sites.

### Method

In order to compare LLNL occurrence reports to occurrence reports from other DOE sites, we need a way to normalize (or standardize) data from the sites. DOE sites vary widely in their budgets, populations, and scope of work and these variations may affect reporting frequency. In addition, reports are required for a wide range of occurrence types, some of which may not be applicable to all DOE sites. For example, one occurrence reporting group is Group 3, Nuclear Safety Basis, and not all sites have nuclear operations. Because limited information is available for all sites, the sites were normalized based on best available information.

In order to compare LLNL occurrences to occurrences at other DOE sites, site effort hours were extracted from the DOE Computerized Accident Incident Reporting System (CAIRS) and used to normalize (or standardize) the number of occurrences by site. Effort hours are those hours that employees normally work and do not include vacation, holiday hours etc. Sites are responsible for calculating their effort hours and ensuring entry into CAIRS.

Out of the 40 DOE sites that reported occurrences into ORPS during this reporting period, 25 had effort hours available in CAIRS. Using the effort hours and the frequency of occurrences by site, a rate of occurrence frequency per 100 FTE workers was calculated. This rate is similar to the injury/illness frequency rate: the number of injury/illness cases per 100 FTE workers.

To validate that this rate was appropriate to use, we compared the effort hours and the frequency of occurrences by site to determine if a relationship exists between the two, e.g. the more effort hours a site has, the more occurrences they tend to have. This hypothesis was tested using the Pearson Correlation Coefficient Test. The correlation coefficient measures the strength of the linear relationship between effort hours and occurrence frequency. The Pearson Correlation Coefficient Test will determine if the true correlation coefficient is equal to zero (no relationship exists), or if the correlation coefficient is not equal to zero (a relationship exists). Values approaching 1.00 show a more positive correlation. Simple linear regression was also used to display a trend line and to test if a one-way relationship exists between effort hours predicting the number of occurrences a site will have.

Additionally, LLNL was compared to other DOE sites by reporting criteria and significance category, to see if LLNL is reporting occurrences along similar percentages as other DOE sites.

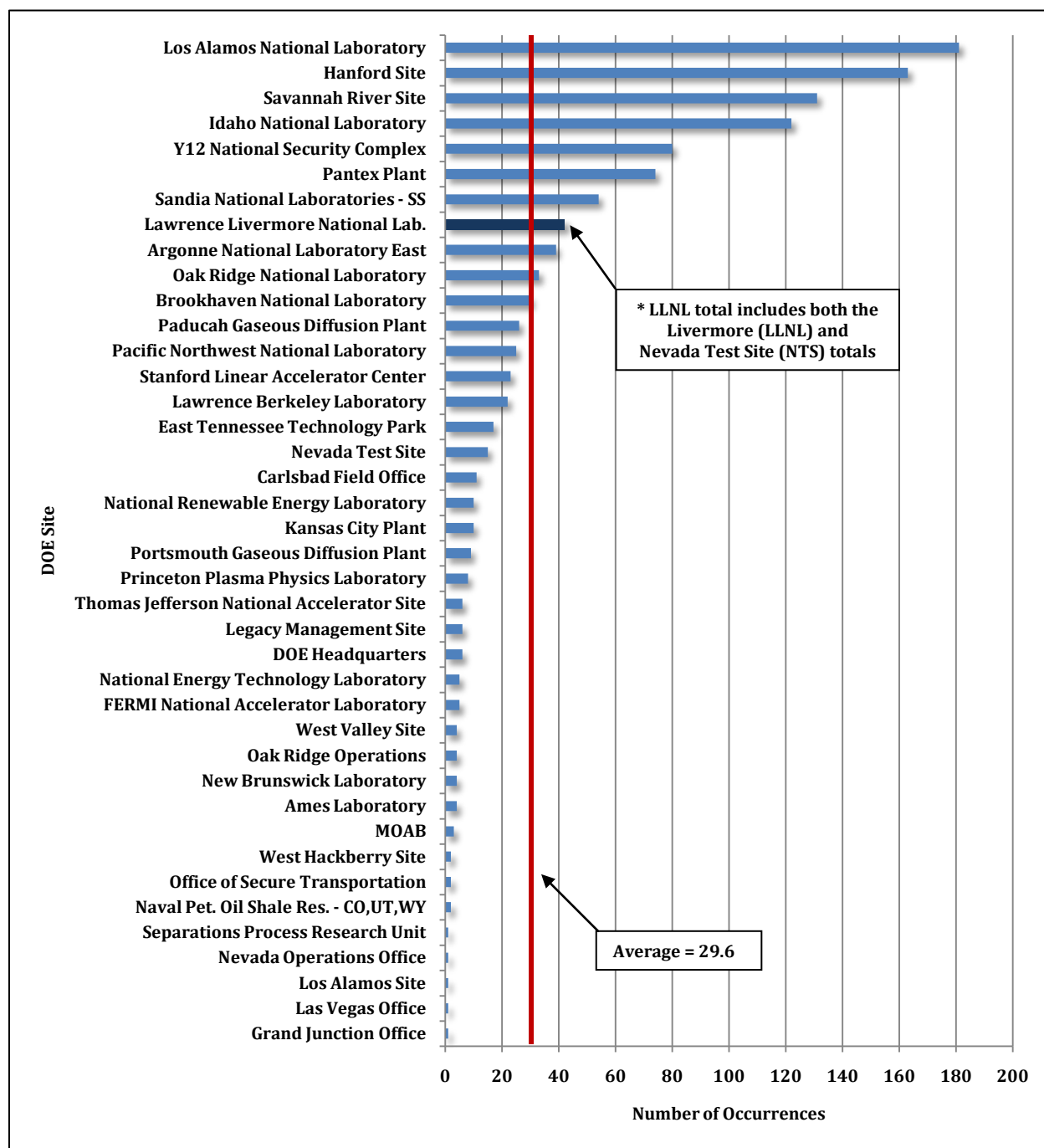
# Performance Analysis of Events

## Results

### Occurrence Reporting Rates

Figure 1 compares 40 DOE sites and field offices by the number of occurrences per site. This figure shows LLNL as the 8<sup>th</sup> highest site, in number of occurrences.

Figure 1 - Occurrence Count by all DOE Sites Reporting to ORPS



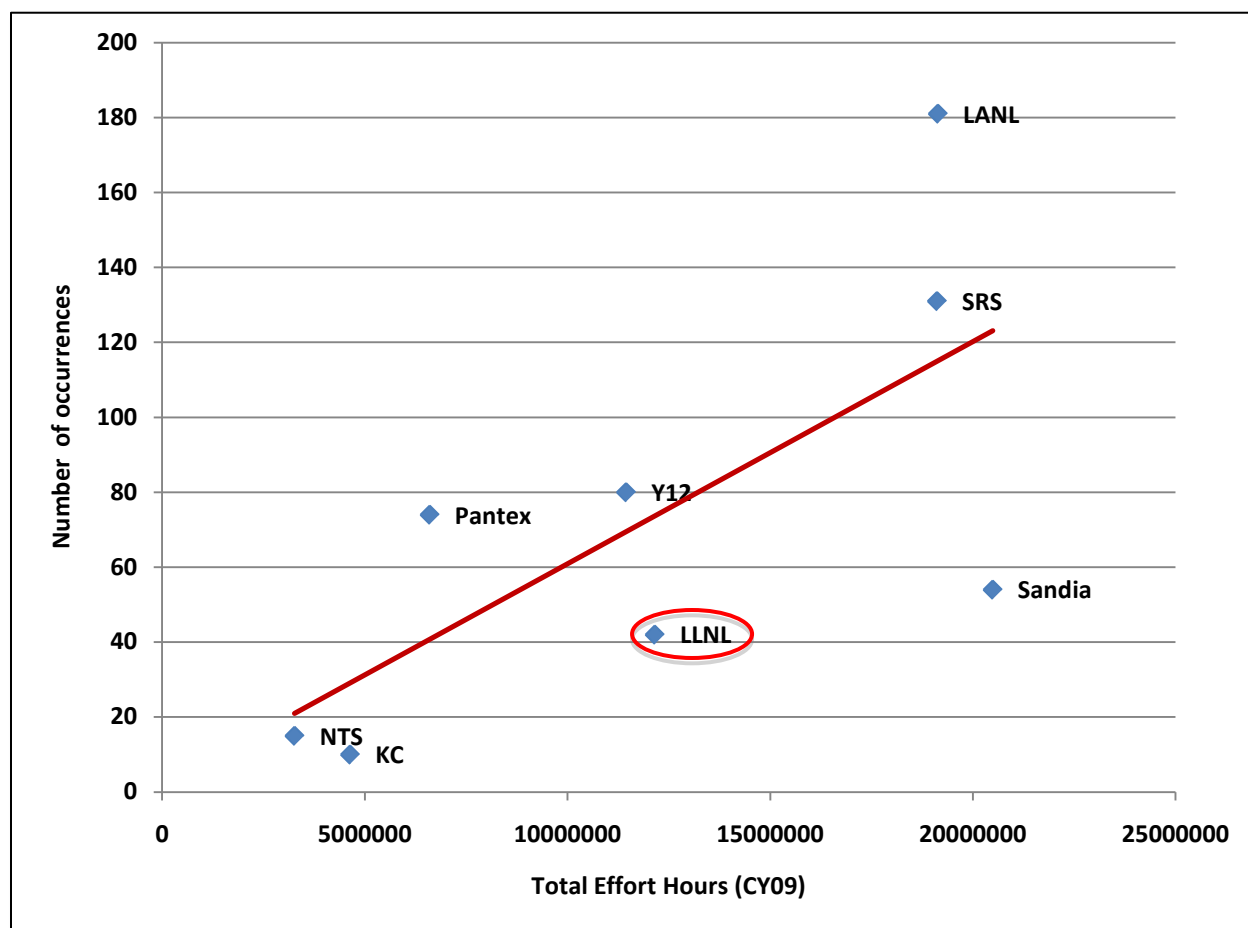
# Performance Analysis of Events

## NNSA Site Comparison

Using the effort hours reported by the NNSA sites reporting to CAIRS, we analyzed the normalized number of occurrences per DOE site to identify outliers. Of these sites, LLNL has the 4<sup>th</sup> highest effort hours for CY09. This analysis indicates that LLNL's rate of 0.69 occurrences per 100 FTE workers is well below the DOE median rate of 0.95, and the NNSA median rate of 1.15. LLNL's rate of occurrences was significantly lower than the previous reporting period, when the LLNL rate was 1.00. During this reporting period, the occurrence rate decreased from 1.00 to 0.69, a 31% decrease. LLNL has experienced a decline in the number of occurrences since July 2009. The decline in reported events is notable but does not seem to indicate a trend of under reporting at this time. LLNL's occurrence report rate is still within the range of expected values, as displayed in Figure 2.

Figure 2 is a scatter graph that displays NNSA site effort hours on the x-axis by the number of occurrences reported on the y-axis. Observationally, this figure shows that effort hours and the frequency of occurrences have a positive relationship: an increase in effort hours will result in an increase in occurrences, and vice versa. The trend line, shown in red in Figure 2 is a result of a simple linear regression. This method fits a line to the plotted data to display the relationship. LLNL has been below the trend line in previous reports.

**Figure 2 - Occurrence frequency by effort hours for NNSA sites**



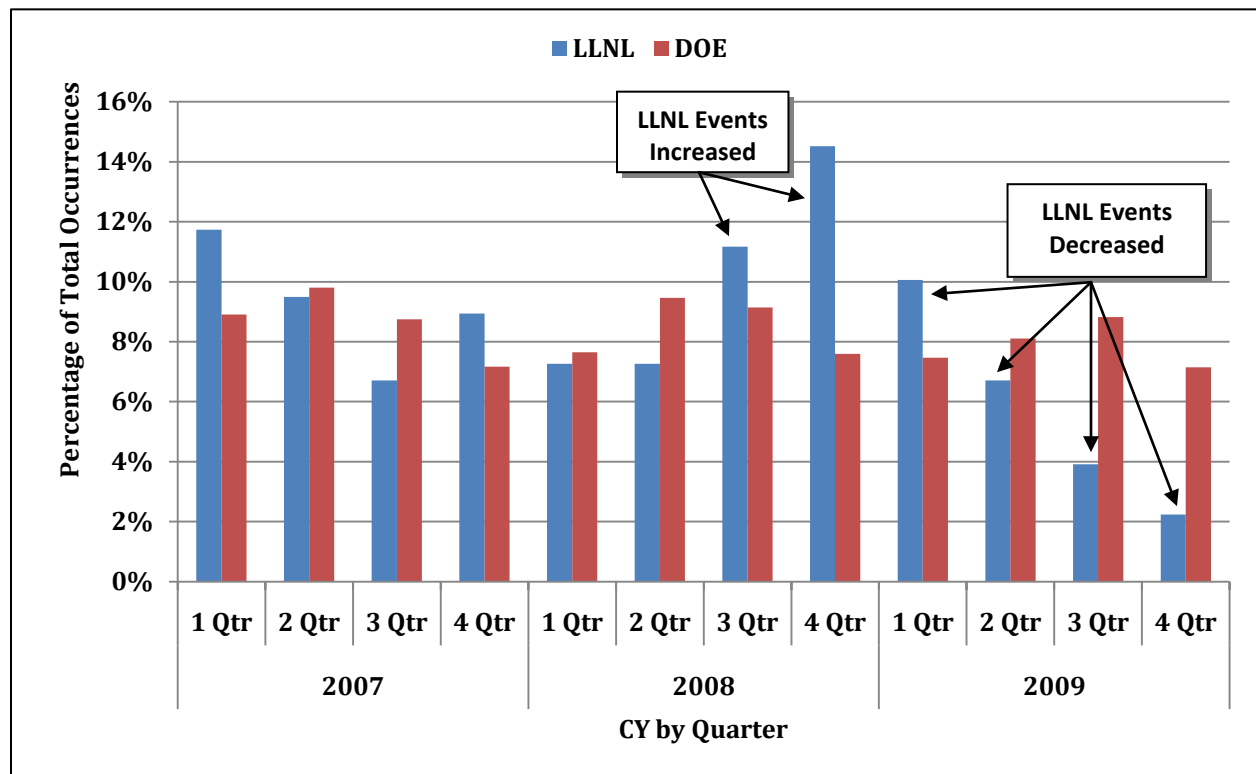
# Performance Analysis of Events

Using the Pearson Correlation test, for the NNSA sites, effort hours and the number of occurrences are significantly and positively correlated with a correlation coefficient of 0.70, as was also seen in the previous reporting period (correlation coefficient of 0.77). All DOE sites are positively correlated with a coefficient of 0.87. As the effort hours increase, so does the number of occurrences and vice versa. Based on the results of the simple linear regression, effort hours were found to predict the number of occurrences.

## Comparison of Total DOE & LLNL Occurrences by Quarter for CY07-09

We wanted to see if the number of occurrences LLNL has experienced over the last three years differs from that of the rest of the complex. Data was gathered for all DOE events for CY07-09, and the percentages of the total for DOE and LLNL were compared, by quarter. The results are shown in Figure 3, below.

**Figure 3 Comparison of Total DOE & LLNL Occurrences by Quarter for CY07-09**



As can be seen from figure 3, LLNL's percentage of total events by quarter was within 4 percent of the DOE totals for the same quarter until the fourth quarter, 2008. Starting in the 3<sup>rd</sup> quarter 2008, LLNL showed a marked increase in events, by percentage of total, than did the rest of the complex. This continued into the next quarter, but then LLNL showed a steady decrease in events compared to the DOE complex in the last three quarters of CY09.

# Performance Analysis of Events

## Comparison of Total Occurrences by First and Last Six-Month Periods in CY09

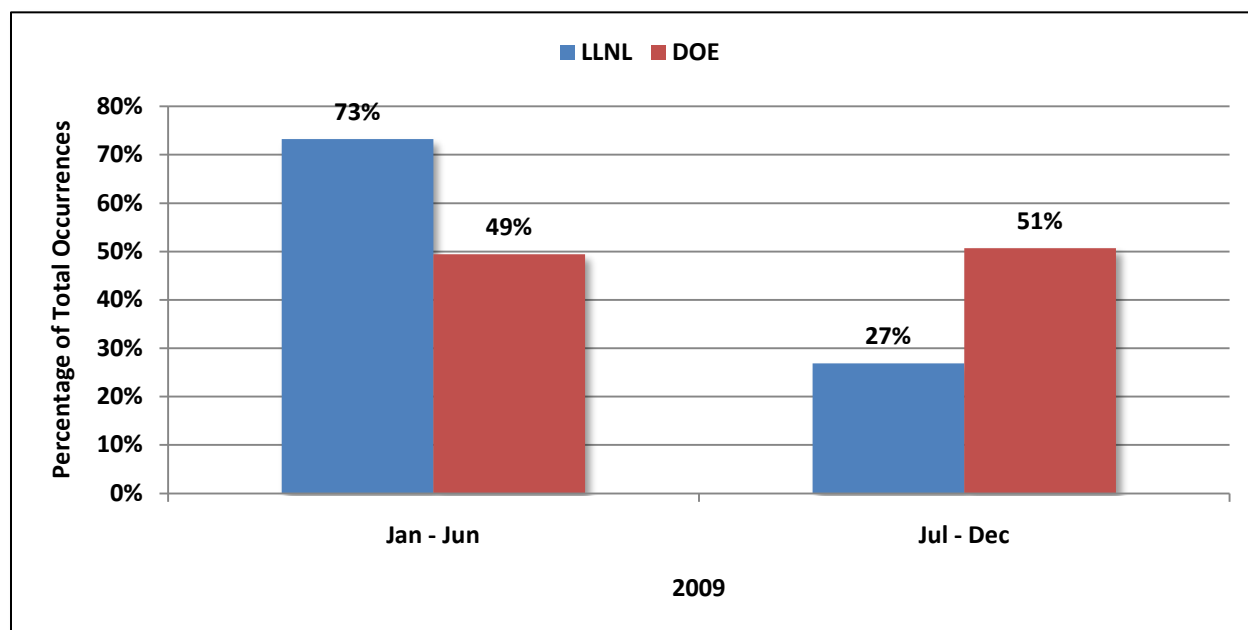
As mentioned earlier, LLNL experienced a significant decrease in reported events in the last six months of CY09. The number of events for all DOE sites was compared to LLNL in two six-month periods; January through June and July through December, 2009. The results are as follows.

LLNL experienced 41 total reportable occurrences in CY09; 30 (73% of total) from January through June, and 11 (27 % of total) from July through December.

The DOE experienced 1,183 reportable occurrences in CY09; 584 (49% of total) from January through June, and 599 (51 % of total) from July through December.

Figure 4, below, shows the comparison of occurrences by percentage of total, for LLNL and DOE, by the first and second half of the CY.

**Figure 4 – Comparison of LLNL and DOE Occurrences by Percentage of Total, for Two Periods**



While DOE reported essentially equal numbers of events (49 vs. 51% of total) between the two six-month periods, LLNL showed a marked decrease in reporting in the second half of the CY. LLNL reporting rebounded in October, continuing into CY10, as the decreasing trend was abated.

The analyst could not determine a cause for the decreasing, but relatively temporary, trend in the second half of CY09.

# Performance Analysis of Events

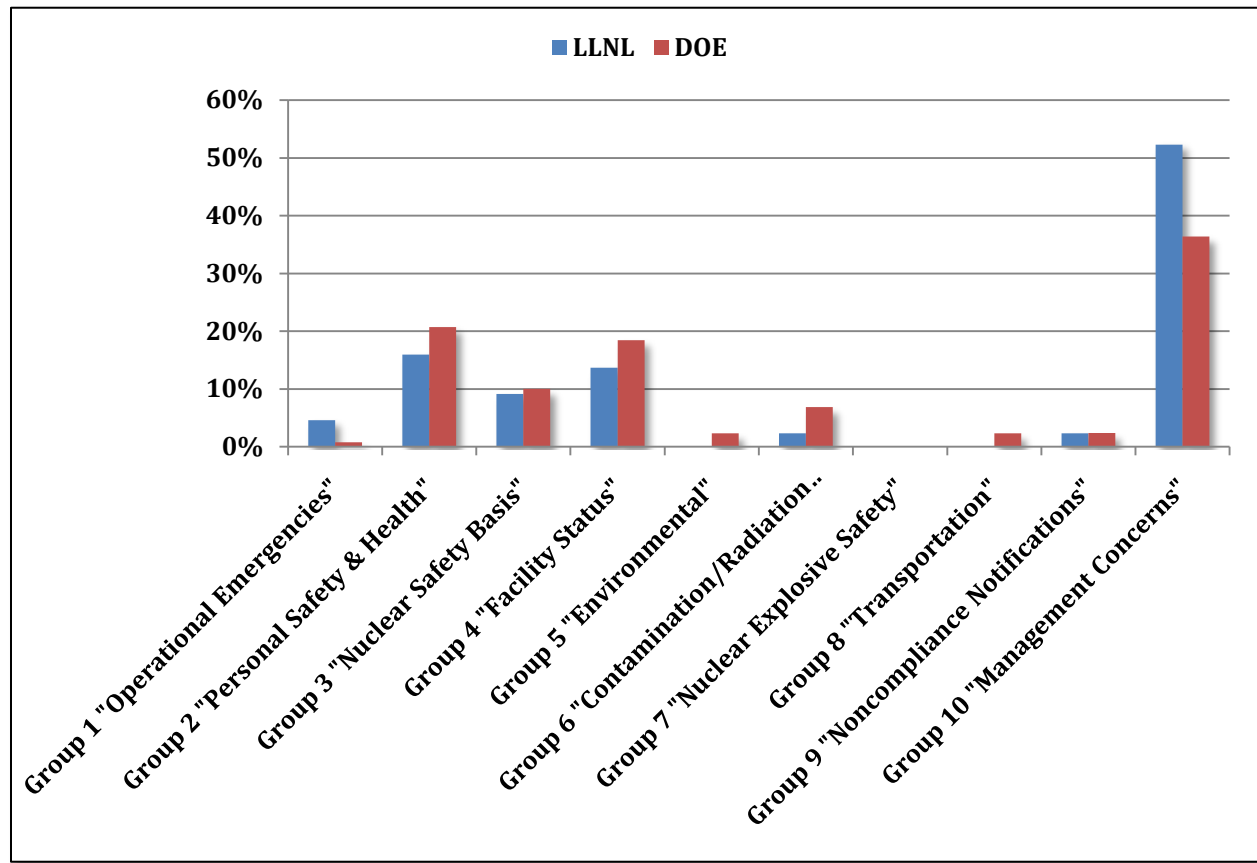
## Occurrence Reporting Group Comparison

Occurrences within the DOE complex are categorized by reporting criteria groups. There are 10 major groups, as shown below:

- Group 1 "Operational Emergencies"
- Group 2 "Personnel Safety & Health"
- Group 3 "Nuclear Safety Basis"
- Group 4 "Facility Status"
- Group 5 "Environmental"
- Group 6 "Contamination/Radiation Control"
- Group 7 "Nuclear Explosive Safety"
- Group 8 "Transportation"
- Group 9 "Noncompliance Notifications"
- Group 10 "Management Concerns"

In Figure 5, LLNL is compared to all DOE sites reporting occurrences in ORPS, by reporting criteria group. Reporting criteria groups are displayed as percentages against the total number of occurrences.

**Figure 5 - LLNL and DOE Sites Occurrence Reporting Group Comparison**



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As can be seen from Figure 5, for the most part, LLNL reported occurrences by criteria group in similar percentages as the other DOE sites reporting occurrences in ORPS. Slightly over one-third of all DOE complex occurrences, and slightly over one-half of all LLNL occurrences in CY09 were filed under the “Management Concern” (Group 10) reporting criteria. As described in the previous report, LLNL experienced two “Operational Emergencies” (Group 1), but no Environmental (Group 5), or “Nuclear Explosive Safety” (Group 7) occurrences.

## Occurrence Significance Category Comparison

Occurrences within the DOE complex are assigned a significance category, based on the severity of the event. There are six significance categories, as shown below:

Operational Emergencies (OE) – Operational Emergency Occurrences are the most serious occurrences and require an increased alert status for onsite personnel and, in specified cases, for offsite authorities.

Significance Category 1 – Occurrences in this category are those that are not Operational Emergencies and that have a ***significant impact*** on safe facility operations, worker or public safety and health, regulatory compliance, or public/business interests.

Significance Category R – Occurrences in this category are those identified as ***recurring***, as determined from the periodic performance analysis of occurrences across a site.

Significance Category 2 – Occurrences in this category are those that are not Operational Emergencies and that have a ***moderate impact*** on safe facility operations, worker or public safety and health, regulatory compliance, or public/business interests.

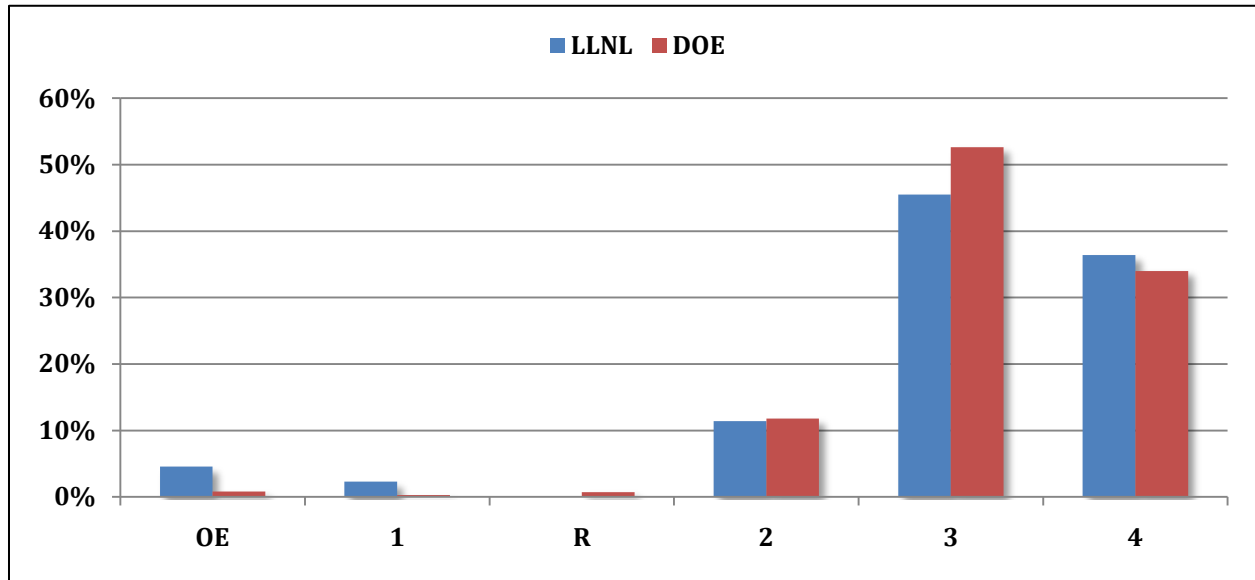
Significance Category 3 – Occurrences in this category are those that are not Operational Emergencies and that have a ***minor impact*** on safe facility operations, worker or public safety and health, regulatory compliance, or public/business interests.

Significance Category 4 – Occurrences in this category are those that are not Operational Emergencies and that have ***some impact*** on safe facility operations, worker or public safety and health, public/business interests.

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In Figure 6, LLNL is compared to all DOE sites reporting occurrences in ORPS, by reporting significance category. Reporting significance categories are displayed as percentages against the total number of occurrences.

**Figure 6 - Occurrence Significance Category Comparison; LLNL and DOE Sites**



As can be seen from Figure 6, LLNL reported occurrences by significance category in roughly the same percentages as the other DOE sites reporting occurrences in ORPS. Slightly over half of the DOE occurrences are assigned a significance category of “3,” compared to about 45 percent for LLNL. LLNL experienced two significance category “OE,” one 1 and one R occurrences. These percentages are roughly the same as are seen in previous reports.



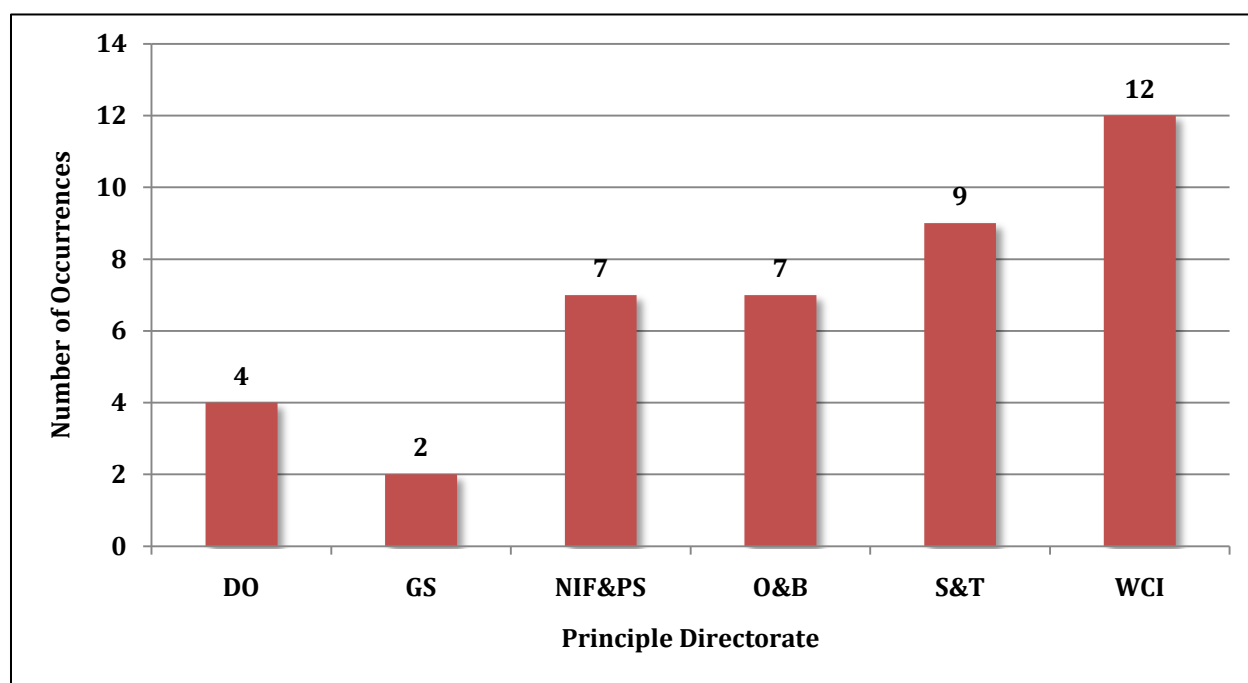
### 3.0 Analysis of Occurrences (ORPS-reportable and Site-reportable)

This section provides an analysis of LLNL events reported to ORPS and other events not meeting the ORPS reporting thresholds, but deemed reportable at the site level (below-ORPS or “Site-reportable” occurrences). The below-ORPS reportable groups and subgroups are listed in Appendix C.

#### ORPS-Reportable Occurrences

LLNL reported 41 occurrences to DOE during CY09. The distribution of occurrences by principle directorate is listed in Figure 7.

**Figure 7 - Total Occurrences by LLNL Principle Directorate**

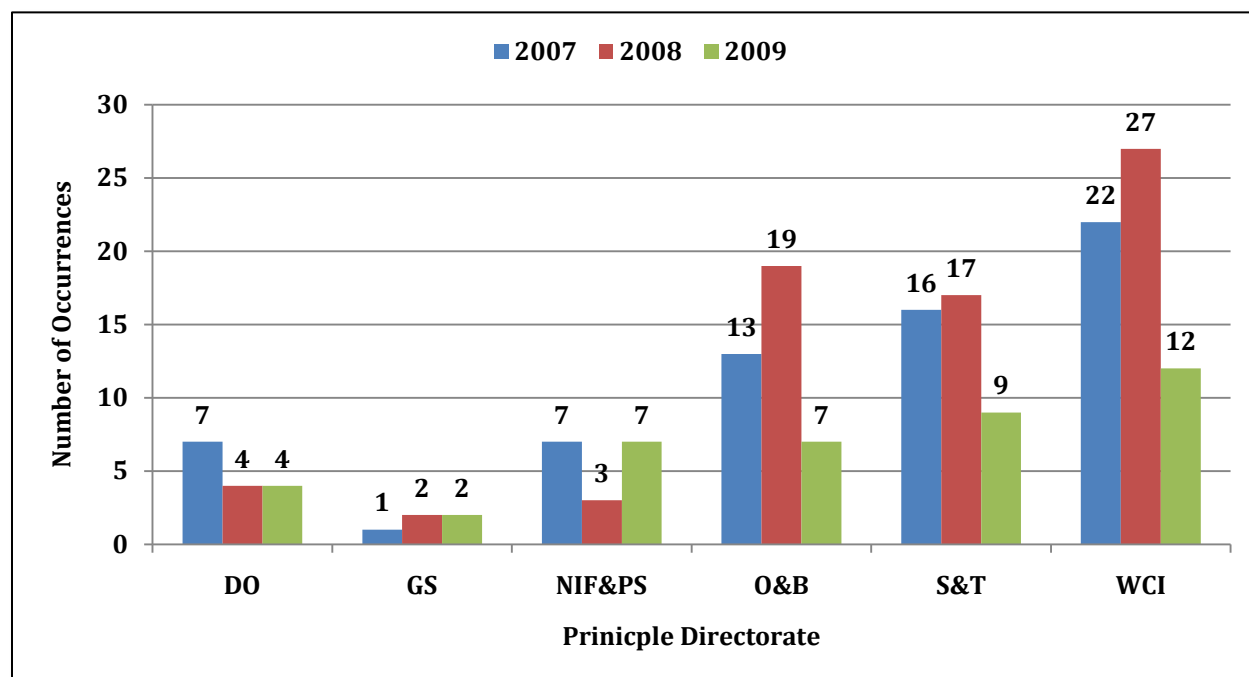


For CY09, the number of events decreased from 59 in the previous report to 41 in this report – a significant decrease in the total number of reports for the year. The number of reported events declined in the last six months of the year (11 events), compared to the first six months (30 events). The analysis of the events does not indicate that the decrease in reporting during the last half of CY09 is of concern. In fact, the decreasing trend abated in October, with reporting levels returning to near normal rates in the first three months of CY10. This decrease in events during the last half of CY09 can be viewed positively – fewer total events in this timeframe. Three out of six principle directorates experienced fewer events in CY09, compared to CY08. Two had the same number of events and one principle directorate showed an increase in events from three to seven, compared to CY08.

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A comparison between CYs 07-09 by principle directorate is depicted in Figure 8, below.

**Figure 8 - Occurrences by Principle Directorate; CY07, CY08 and CY09**



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## Summary of ORPS-reported Occurrences by Reporting Criteria Group

In the DOE occurrence reporting system, there are 10 major reporting criteria groups, and 15 subgroups. (See Appendix B – “ORPS Reporting Criteria Groups and Subgroups”) The 41 occurrences reported in CY09 are divided among the 44 reporting criteria groups discussed below.

Three of the 41 ORPS-reported occurrences contained multiple reporting criteria codes, representing additional concerns or actions taken as a result of the respective events that prompted reporting under more than one criteria code. Two of these occurrences were detailed in the previous report. One of these events involved unauthorized electrical work which was reported under both the Group 2C “Hazardous Energy Control,” and the Group 10(3) “Near Miss” criteria, due to the nature of the event. The second event was the vehicle fatality in June 2009; this event prompted a DOE Type A investigation, which necessitated the addition of a 10(1) reporting criteria code (“Any event resulting in the initiation of a Type A or B accident investigation as categorized by DOE O 225.1A, Accident Investigation.”). The third event was a potential inadequacy in a documented safety analysis, reported under the Group 3B criteria, and later upgraded to a positive USQ determination, requiring the addition of the 3A criteria code.

The 44 ORPS-reported reporting criteria for the 41 CY09 events are as follows:

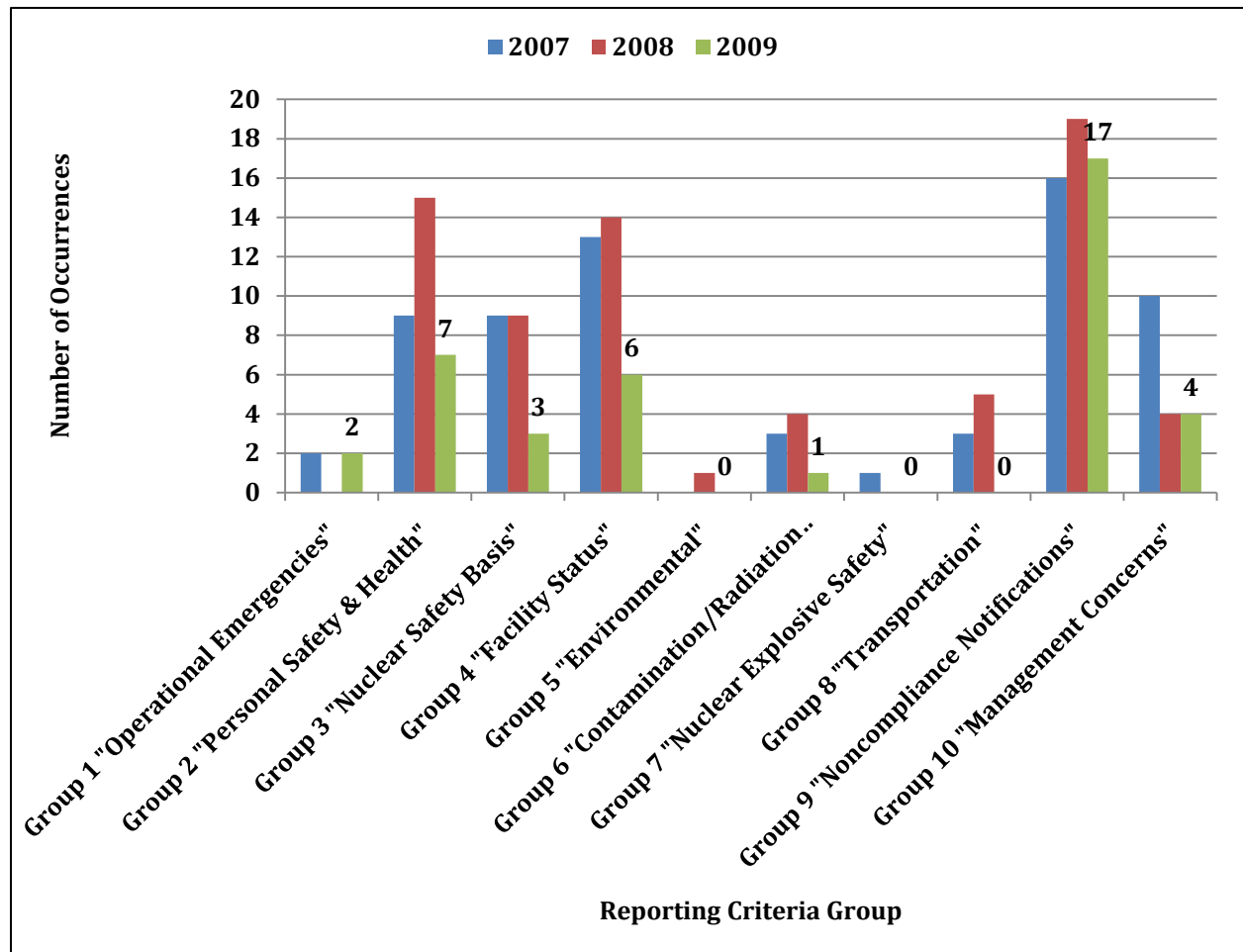
- Two were classified as “Operational Emergencies” (Group 1) occurrences. These were wildland fires at Site 300 during June 2009. These were described in the previous report.
- Seven were classified as “Personnel Safety & Health” (Group 2) occurrences representing a vehicle-related fatality, fractures, electrical shock, and failure to follow proper Lockout/Tagout (LOTO) protocols. There were eleven Group 2 events reported in the previous report.
- Three were classified as “Nuclear Safety Basis” (Group 3) occurrences representing technical safety requirement violations, positive USQ determinations, and Potential Inadequacies of Documented Safety Analyses (PISA). There were five Group 3 events reported in the previous report.
- Six were classified as “Facility Status” (Group 4) occurrences representing performance degradation of facility safety systems, facility evacuation, discovery of Suspect/Counterfeit (S/CI) or defective items. There were 11 Group 4 events reported in the previous report.
- One was classified as “Contamination/Radiation Control” (Group 6) representing spread of radioactive contamination above the limits in 10 CFR 835, Appendix D. There were three events reported for Group 6 in the previous report.
- There was one event classified as a “Noncompliance” (Group 9) occurrences representing written notification of a noncompliance by an outside agency. There were three Group 9 events reported in the previous report.
- 21 were identified as “Management Concerns” (Group 10) that did not meet the threshold of specific DOE reporting criteria. However, LLNL determined these occurrences to be significant and/or of value to share locally or complex-wide. Four

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of these reports concerned “near misses” where no barrier or only one barrier prevented an occurrence from having a reportable consequence. All of the four near miss events were described in the previous report.

Figure 9, below, shows the distribution of occurrences by reporting criteria group for three years, CY07-09. CY09 totals are shown above the columns. (Note – The total number of reporting criteria codes for CY09 represented in the graph (44) is greater than the total number of reports (41) for this period due to multiple codes assigned to certain events, as described above.)

**Figure 9 - LLNL Occurrence Reports by Major Reporting Criteria Group for CY07-09**



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## ORPS-Reported Occurrences by Significance Category (SC)

Occurrences are categorized by the level of consequence when reported. This significance category is defined by the DOE ORPS reporting criteria and determines the level of formality and rigor required in the response. SC 4 reports are considered “final” when they are entered initially, and are not required to list specific causes or corrective actions.

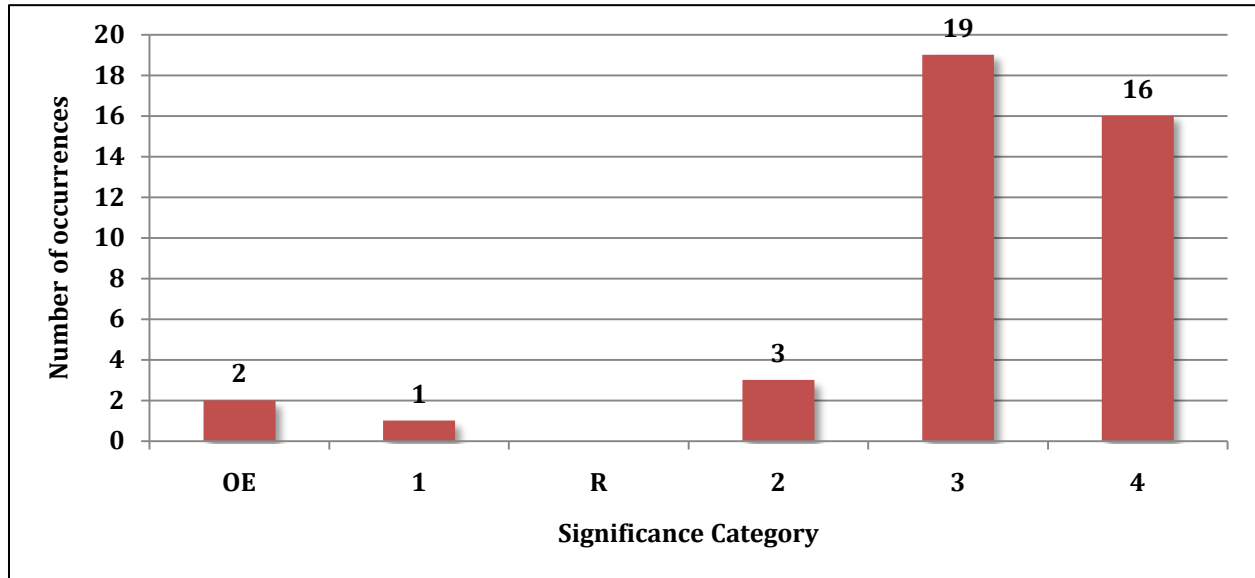
As mentioned above, several occurrences have multiple reporting criteria, and thus several Significance Categories assigned to them. The following describes only the highest SC reported for each of the 41 occurrences in CY09:

- Five percent (2 out of 41) of the occurrences were categorized as “Operational Emergencies (OE),” requiring the activation of the Emergency Operations Center to manage the event. These were wildland fire events at Site 300 in June 2009.
- Two percent (1 out of 41) of the occurrences were categorized as having a “significant impact (SC 1)” on safety (NA--LSO-LLNL-LLNL-2009-0028, “On-Site Vehicle Accident by Building 242 Results in Fatality).
- Seven percent (3 out of 41) were assigned as having a “moderate” impact (SC 2).
- 85% (35 out of 41) of the occurrences reported during this review period were assigned at the lower level of consequence (SC 3 and 4), in ORPS having only “some” or “minor” impact on safe facility operations, worker or public safety and health, regulatory compliance, or public/business interests. This percentage is roughly the same as reported in the previous report (90%) for SC 3 and 4 events.
  - 46% (19) reported as SC “3,” compared with 58% from the previous report
  - 39% (16) reported as SC “4,” compared with 32% from the previous report

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The distribution of LLNL occurrences by significance category is shown in Figure 10.

**Figure 10 - LLNL Occurrence Reports by Significance Category (SC)**



Slightly less than one-half (19 out of 41 or 46%) of all events are categorized as SC 3. This percentage represents a decrease from the previous report where the percentage of SC 3 reports was roughly more than one-half, at 57 percent of all reports.

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## Methods

All occurrences are analyzed for recurrence and trends, but if there are no commonalities in causation or trends are not identified, the occurrences are not discussed in the “Results” section, below. Also, if there were no occurrences within a specific reporting group or subgroup, they are not discussed. Occurrences requiring a discussion are presented by major reporting criteria group below. The Below-ORPS reportable events are also discussed in this section.

The steps used for analyzing the data collected for this report is as follows:

1. Determine which reporting criteria groups to analyze further based on the frequency of events
2. Create control charts for the most frequently occurring events
3. Identify occurrence reporting criteria groups that meet common tests for the control chart results

## Frequency of Events

To determine which reporting criteria groups to analyze further, all occurrences in this reporting period are charted by frequency. A determination was made that events occurring at the rate of three or more per year should be further analyzed with control charts.

## Control Charts

Two types of control charts are used to analyze reportable events: Occurrence *Count* Control Charts and Occurrence *Rate* Control Charts.

### Occurrence *Count* Control Charts

These control charts are used to identify trends and identify processes that may be outside of the expected range of performance.

The occurrence count control charts consist of four key elements:

1. The count of occurrences within a given month by reporting criteria group
2. Centerline: the average number of occurrences over the three years (mean)
3. Upper warning limit (UWL): two times the average moving range divided by a constant with a value of 1.128 above the centerline
4. Upper Control-limit (UCL): three times the average moving range divided by a constant with a value of 1.128 above the centerline

### Occurrence *Rate* Control Charts

In this analysis report, a new methodology for control charting is being introduced for events – the “Individual-X/MR” method, described in *The Introduction to Statistical Quality Control* (Montgomery, 1997). This control charting technique utilizes counts of rare events, and converts the count to an event *rate*. This is of benefit in occurrence reporting because most LLNL events

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do not occur frequently enough for the occurrence count control charts to accurately depict trends. This type of control chart will be used in the future to chart infrequent events.

The occurrence rate control charts consist of four key elements:

1. The event rate for a given categorization date, by reporting criteria group
2. Centerline: the average rate per year
3. Upper warning limit (UWL): two times the average moving range divided by a constant with a value of 1.128 above the centerline
4. Upper Control-limit (UCL): three times the average moving range divided by a constant with a value of 1.128 above the centerline

The UCL is a common calculation for control charts. In an ideal world, the majority of one's data would lie within the range defined by the UCL and a lower control limit. For these control charts, it is three times the average moving range divided by a constant with a value of 1.128 above the centerline. However, since occurrences are tracked on a positive scale the lower control limit does not apply (e.g. negative occurrences do not exist).

The moving range is defined as  $|x_i - x_{i-1}|$ , where  $x$  is the number of occurrences for a specific quarter. It can also be defined as the absolute difference between two successive data points, in this case quarterly occurrence counts. The constant discussed above (1.128), referred to as  $d_2$  in the *Introduction to Statistical Quality Control* is defined as the mean of the distribution of the relative range and is used in calculating the estimate of the standard deviation, which is defined as the average moving range divided by this constant ( $d_2$ ). The value of  $d_2$  ranges anywhere from 1.128 to 3.931 depending on how many observations are included in each sample. Since each data point in the control charts used in this analysis are based on individual counts and not a sample average, the moving range, instead of the range is used. Since the moving range is calculated using two successive data points, our value of  $n=2$ . Therefore the value of  $d_2$  for  $n=2$  is defined as 1.128 in Table VI (Montgomery, 1997).

## Common Tests for Control Chart Results

A control chart can be considered a way of performing a statistical test – a test to determine if the process is in a state of control. Theoretically, if a process is 'in-control,' then none of the data points will fall outside of the UCL. With these charts we are looking for *special causes of variation*. This type of variation can be found by using two common tests:

1. One or more data points falling above the UCL
2. Two or more consecutive points above the UWL

A single point above the UCL or two consecutive points above the UWL is considered above an action limit.

We used the following decision rules to determine which occurrence reporting criteria groups required additional explanation. If one data point is above the UCL, two consecutive points are



# Performance Analysis of Events

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above the UWL, or there is evidence of an increasing trend over more than one month for any reporting criteria group, it was analyzed further and the result is presented in this report.

In addition, occurrence reporting criteria groups were analyzed if any of the below decision rules are met:

- Single increase in data for a specific data interval (month or categorization date)
- Increasing trend over more than one specific data interval (month or categorization date)
- One point above the UWL

## Average Number of Days Between Events

Along with the occurrence rate control charts for those reporting criteria groups with fewer occurrences, the average number of days between occurrences was calculated for CY07, CY08 and CY09, to analyze three separate 12-month rolling periods.

The higher the average number of days between occurrences suggests that LLNL is experiencing a decreasing trend for these occurrences. An analysis of variance was used to test for a difference in the average number of days between three review periods: CY07, CY08 and CY09. A p-value of less than a significance level of 0.05 was considered statistically significant.

## Watch List items

Reporting criteria groups that meet the decision rules but are determined to not be recurring based on common cause analysis shall be placed on the Watch List to be analyzed in the subsequent report.

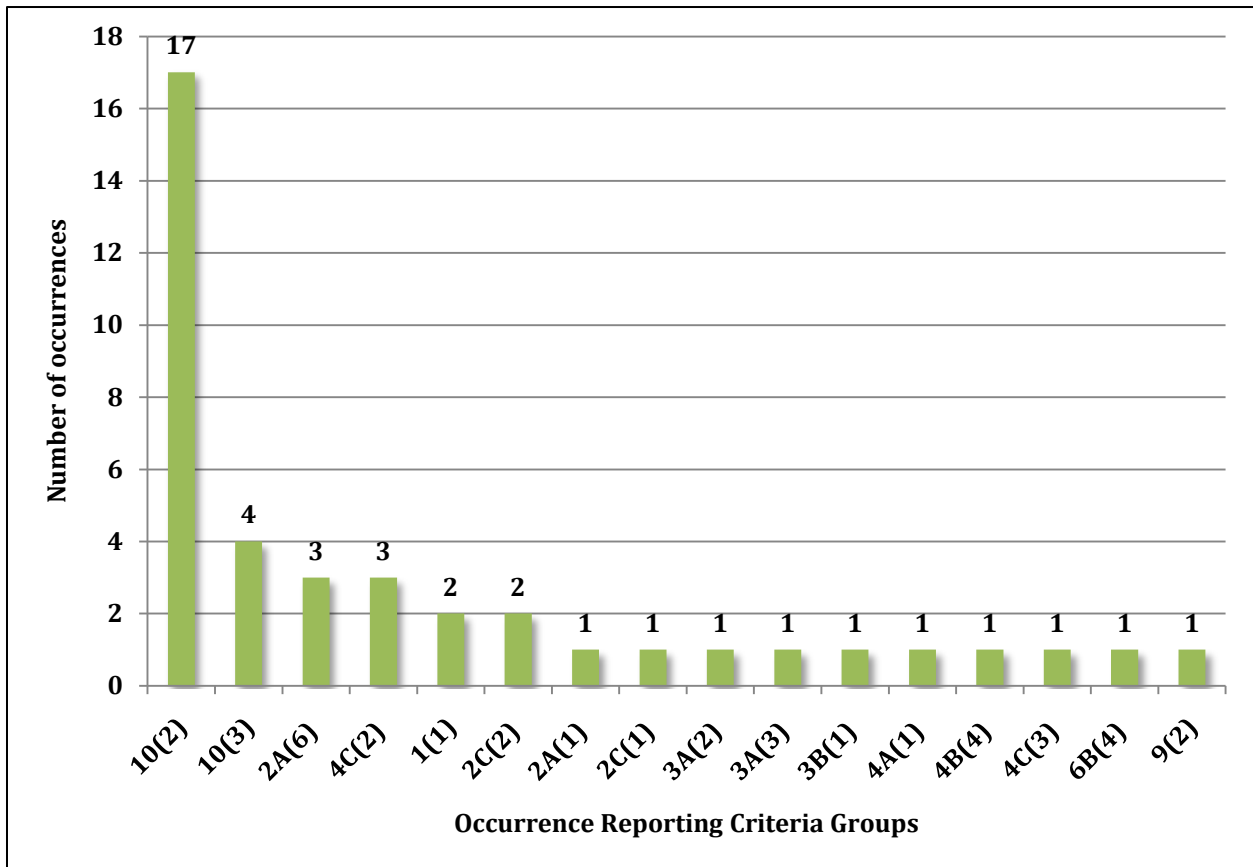
# Performance Analysis of Events

## Results

### Occurrence Reporting Criteria Groups by Frequency

To determine which reporting criteria groups to analyze further, all occurrences in this reporting period are charted by frequency. Events occurring at the rate of three or more are further analyzed with control charts, as mentioned in the methods section, above. Figure 11 shows the distribution of occurrence reporting criteria groups by frequency.

**Figure 11 – Number of LLNL Occurrences by Reporting Criteria Group**



Occurrences in four reporting criteria groups were reported most frequently (three or more events). These reporting criteria groups most frequently cited are shown in Table 1, below.

# Performance Analysis of Events

**Table 1 - Reporting Criteria Groups Reported Most Frequently (3 or more events)**

Reporting Criteria	Group	Subgroup	Occurrence Reporting Criteria
2A(6)	Personnel Safety and Health	Occupational Illnesses/Injuries	Any single occurrence resulting in a serious occupational injury. A serious occupational injury is an occupational injury that: Requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; Results in a fracture of any bone (except simple fractures of fingers, toes, or nose, or a minor chipped tooth); Causes severe hemorrhages or severe damage to nerves, muscles, or tendons; Damages any internal organ; or causes second- or third-degree burns, affecting more than five percent of the body surface.
4C(2)	Facility Status	Suspect/Counterfeit and Defective Items or Material	Discovery of any suspect/counterfeit item or material other than office supplies, equipment, or household products
10(2)	Management Concerns/Issues	N/A	Occurrence not meeting other criteria, but considered to be of safety significance or concern
10(3)	Management Concerns/Issues	N/A	A near miss

Occurrences reported in these four reporting criteria groups were analyzed using the controls charts described previously, using three years of data. The charts are displayed below. The X-axis on the “rate” charts lists the dates of events over the three-year period, CY07-09. The first data point on the X-axis is the first event of that reporting criteria in this three-year period. The X-axis on the “count” chart represents a full three-year period, CY07-09. The events are listed chronologically when they occurred in the three-year period.

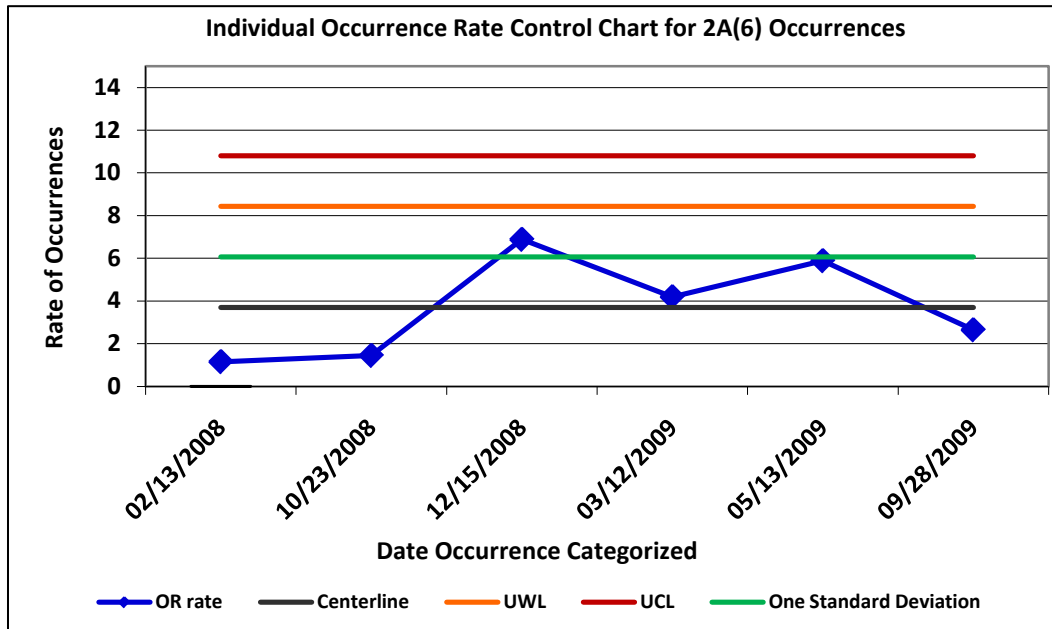
The purpose of this analysis is to determine which groups of occurrences to analyze further and on which to focus additional attention. The occurrence *rate* control charts are utilized to analyze the 2A(6), 4C(2) and 10(3) events, because of their smaller total number of events (relatively rare), and the occurrence *count* control charts are used to analyze the 10(2) Management Concern events, because they are more numerous.

The “Management Concern,” 10(2) and “Near Miss, 10(3),” reporting criteria are those events that do not meet the threshold for reporting in any other ORPS reporting criteria group, but are of concern to management. The majority of LLNL’s events fall into the Group 10 reporting criteria. Many of the reporting criteria groups include events that were discussed in previous reports – where this is applicable, it is noted, below.

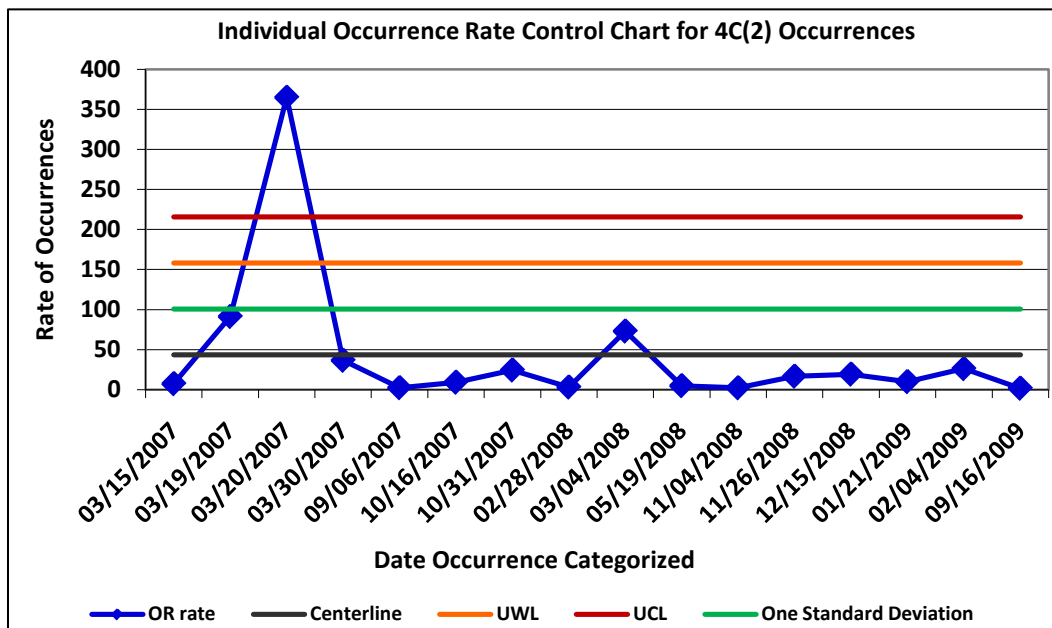
# Performance Analysis of Events

## Occurrence Rate Control Charts for the 2A(6), 4C(2) and 10(3) Occurrences

### 2A(6) “Personnel Safety and Health/ Occupational Illnesses/Injuries”

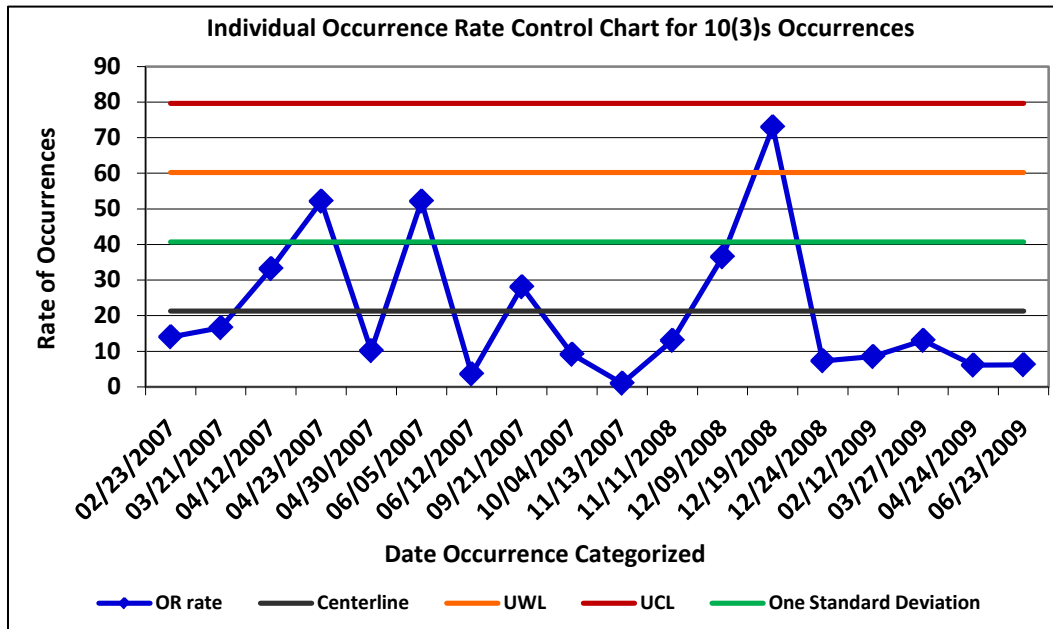


### 4C(2) “Facility Status/Suspect/Counterfeit and Defective Items or Material”



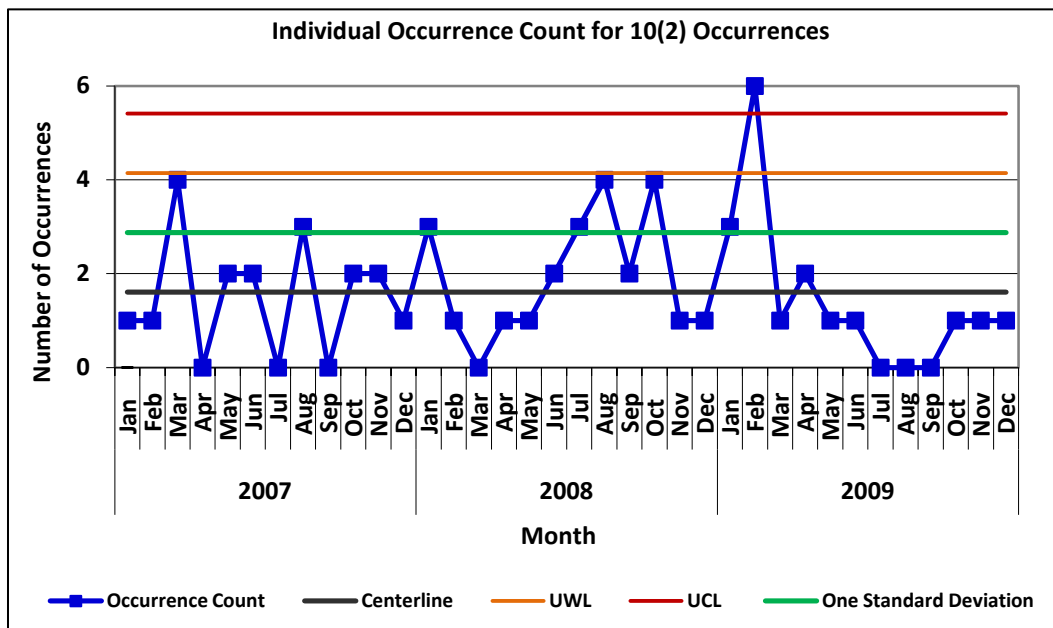
# Performance Analysis of Events

## 10(3) “Management Concerns/Issues- Near Miss”



## Occurrence Count Control Chart for the 10(2) Occurrences

### 10(2) “Management Concerns/Issues”



# Performance Analysis of Events

Where the reporting criteria group control chart results indicated that the occurrences were above the action limit or additional explanation was appropriate, the cell in Table 2, below, is shaded. The analysis using the control charts resulted in the identification of five reporting criteria groups (rows with shading in Table 2) needing further evaluation. It should be noted that having a single occurrence in a three-year period will typically cause that point to be above the UCL – these reporting criteria groups are investigated, but usually do not result in further analysis, and are not discussed further.

**Table 2 - Summary of Control Chart Findings by Reporting Criteria Group**

Reporting Criteria with Control Charts	Point above the UCL	Two consecutive points above UWL	Point above the UWL & below the UCL	Increasing trend during this reporting period?	Recent increasing trend more than one month?	On Watch List from Previous Report?
2A(6)	No	No	No	No	No	No
4C(2)	No	No	No	No	No	No
10(2)	Yes	No	No	Yes	Yes	No
10(3)	No	No	No	Yes	No	No

To summarize the Table 2, above:

- One reporting criteria, 10(2) – “Management Concerns,” had a point above the UCL
- No reporting criteria had two consecutive points above the UWL
- No reporting criteria had points between the UWL and the UCL
- Two reporting criteria, 10(2) – “Management Concerns,” and 10(3) – “Near Miss,” had an increasing trend at some point during the reporting period
- One reporting criteria, 10(2) – “Management Concerns,” had an increasing recent trend for more than one month
- No reporting criteria were on the Watch List from previous reports

All of the groups that represent shaded areas in Table 2 were discussed in the previous report.

Additionally, there were two reporting criteria with a small number of events (infrequent events), Group 1(1), “Operational Emergencies,” and Group 2A(1), “Personnel Safety and Health, Occupational Illnesses/Injuries, (fatality),” that are of high importance, and are discussed in the results section, below.

# Performance Analysis of Events

## Average Number of Days Between Events

An analysis of variance was used to test for a difference in the average number of days between three review periods: CY07, CY08 and CY09. A p-value less than a significance level of 0.05 was considered statistically significant.

The average number of days for the four reporting criteria groups that occurred most frequently and all reporting criteria is shown in Table 3, below.

**Table 3 - Average Days Between Occurrences by Reported Criteria**

Average Days Between Occurrences by 12 Month Intervals				
Reporting Criteria	CY07	CY08	CY09	p-value
2A(6)	103	208	96	0.44
4C(2)	41	69	92	0.53
10(2)	20	16	21	0.74
10(3)	37	102	48	0.41
All LLNL Events	5	5	8	0.02

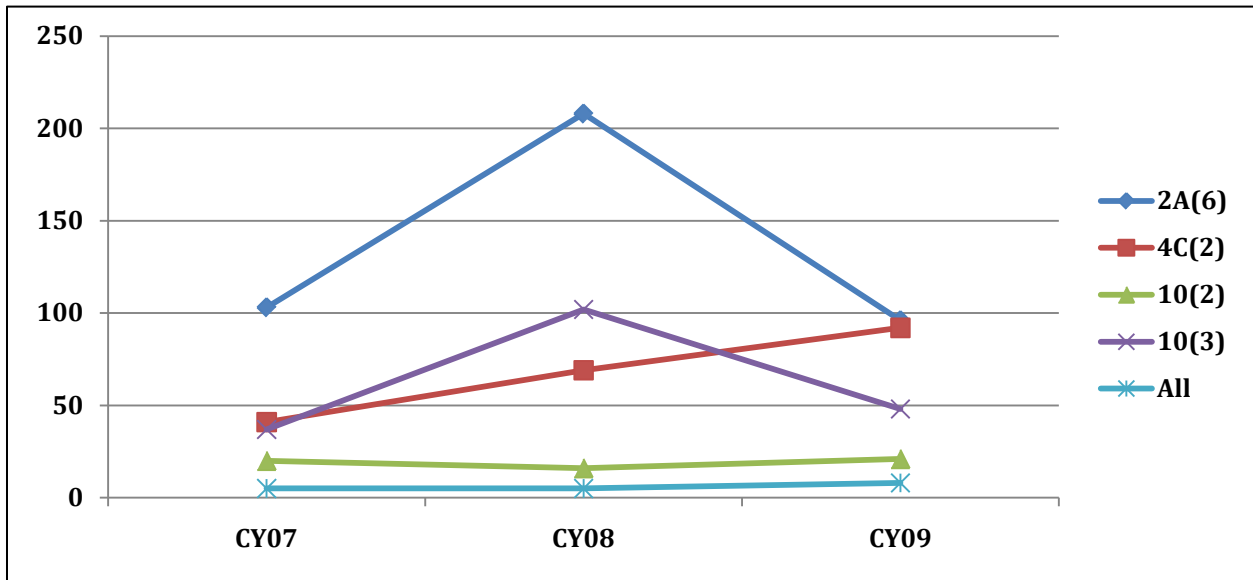
For CY09, LLNL experienced an increase in the average number of days (8) for all events, meaning there were fewer occurrences on average over the period, compared to previous 12-month periods. This is the first time in recent reports where there has been a statistical difference in the average number of days between events. The p-value for the average number of days between events for all reporting criteria is 0.02, as depicted in Table 3, above.

For the four reporting criteria where events occurred on a more frequent basis (three or more per period), the p-values were not statistically significant. These reporting criteria are shown in Figure 12, below.

We experienced a decrease in the number days between the 2A(6) and 10(3) events, as these events occurred more frequently, and an increase in the average number of days between 4C(2) and 10(2) events. However, for all groups, the number of days between occurrences reporting the same reporting criteria was not significantly different from previous reporting periods.

## Performance Analysis of Events

Figure 12 - Average Days Between Occurrences by Reporting Criteria Group



### Total Number of Events for CY09

For the first-half of CY09 there were 30 reportable events. There were only 11 events in the last-half of the calendar year. The analysis did not indicate that this decreasing trend in reporting for the last half of the year was of significance. In fact, the decreasing trend reversed starting in October, and the reporting of events increased steadily into the first three months of 2010.



# Performance Analysis of Events

## ORPS-Reportable Events

### Reporting Group 10, “Management Concerns/Issues”

**10(2) – “Management Concern – An event, condition, or series of events that does not meet any of the other reporting criteria, but is determined by the Facility Manager or line management to be of safety significance or of concern to other facilities or activities in the DOE complex.”**

Management can report any event that does not fall into another reporting criteria as a 10(2) Management Concern, and frequently does. On occasion, an event that does not rise to the level of ORPS reportability is viewed as being important enough to report, in order to let others in the complex know of the concern.

The 10(2) criteria is the most frequently reported criteria group throughout the DOE complex, and at LLNL. Of the 44 separate reporting criteria assigned to the 41 occurrences, 17 (39%) represent occurrences of this type.

Nine management concern occurrences were reported within a two-month period in this reporting period (January & February 2009) that caused a point to be above the UCL, and an obvious increasing trend. The next occurrences of this type were seen in March and April, with three events. Subsequently, there was one occurrence in each following month, May and June 2009. There were no 10(2) events in July through September. But, in October, November and December, there was one event per month.

In CY07, there was an average of 20 days between these events. In CY08, the average was 16 days. During CY09, the average was 21 days between events. The frequency of the 10(2) events has increased, as evidenced by the average number of days between events, however, given that these events represent over a third of all occurrences on site, the averages are within the expected range. Additionally, the spike in 10(2) events in early 2009 was not repeated, and the event frequency has decreased.

The 10(2) occurrences and their associated causes reported in CY09 are listed in Table 4, below.

**Table 4 – 10(2) “Management Concern” Occurrences and Associated Causes**

OR Number	Title	Cause(s)
NA--LSO-LLNL-LLNL-2009-0003	Legacy Beryllium Contamination Discovered Inside Toolbox In Building 321A	Work controls required that items be surveyed only if contamination was suspected. This direction did not provide specific enough guidance to workers and did not allow for gaps in worker knowledge.  The toolbox was not labeled as potentially contaminated with legacy beryllium.

# Performance Analysis of Events

OR Number	Title	Cause(s)
NA--LSO-LLNL-LLNL-2009-0008	Building 801 Momentary Entry Into Contained Firing Facility Chamber Without Respirator Filter	<p>Worker was new to the cleanup process. Facility Manager directed exercises that tested the entire cleanup crew response to abnormal conditions. Worker was clearly slower than the more experienced members of the team in the donning and doffing process.</p> <p>The team did not have a structured process of checking one another's PPE prior to entry into the buffer zone.</p> <p>Worker performed a sequence of steps that is not frequently performed.</p> <p>The decontamination team leader did not consciously evaluate whether the task of replacing damaged PPE was consistent with Worker's experience base.</p> <p>The location of the respirator filter cartridge on the back side of the Tyvec meant that it was out of Worker's normal line of sight.</p> <p>Although an operator aid was previously developed to help personnel check their own PPE and that of others prior to entry into the buffer area, this aid was not posted in the work area.</p>
NA--LSO-LLNL-LLNL-2009-0009	Copper Conductor Left In Electrical Cabinet Causes Short in Building 117	<p>The task list provided by the subcontractor was less than adequate.</p> <p>The assigned subcontractor superintendent was in training. It was recognized that this superintendent had not fully developed all of the required skills. The subcontractor did not provide adequate mentoring and coaching of this "green" superintendent.</p> <p>The specifications for the work scope were less than adequate.</p> <p>The current LLNL AHJ building-required inspection program is general in nature and does not focus on specific components or individual pieces of equipment.</p>

## Performance Analysis of Events

OR Number	Title	Cause(s)
NA--LSO-LLNL-LLNL-2009-0012	Worker Struck on Head by Unexpected Closure of Roof Hatch Cover in Trailer 1677	<p>The hatch was supported by 2 pneumatic pistons - each piston is designed to exert a force of 60 lbs. when it is fully extended. Post event analysis revealed that the two pistons were not operating correctly and found to be outside the operational criteria.</p> <p>The roof hatch has a fully open position at 74 degrees. Analysis revealed that the roof hatch will close by gravity when displaced approximately 13 inches, accelerating as it lowers. This shows that the hatch did not have a stable or locking ability in the open position. And, the pneumatic piston end fitting is designed to accept a wire safety clip to prevent disconnection. The safety clips were not present in this installation.</p> <p>F&amp;I did not assure that the pistons used to hold the roof hatch open were of adequate quality/installation.</p>
NA--LSO-LLNL-LLNL-2009-0018	Management Concern over Building 695 Operations	<p>The filing of the TSRs was not completed until the final report was issued.</p> <p>The IA was delayed and consequently there was no report for the facility management to use in their evaluation. Because of this, there was an extended delay in the facility declaring the PISA and the TSR Violations.</p>
NA--LSO-LLNL-LLNL-2009-0020	On-Site Procedures Not Followed in Movement of Radiological Material	<p>The root cause for this event was determined to be the lack of a clear, documented process governing the transfer of forensic evidence within LLNL and to offsite locations by exempt government agencies.</p> <p>The apparent cause was identified as the improper transfer of radioactive material between LLNL facilities.</p>

## Performance Analysis of Events

OR Number	Title	Cause(s)
NA--NVSO-LLNV-LLNV-2009-0001	Measurable Radioactive Release to the JASPER Secondary Confinement Chamber Vessel	<p>Shelf life exceeded: The shot 86 target material was stored for approximately six months prior to being used in the experiment. The properties of the phase of the metal used for the shot 86 target and the extended storage time may have contributed to higher than usual levels of loose surface contamination due to oxidation.</p> <p>System interactions not considered.</p> <p>Increased contamination within the inside of the bellows assembly, and therefore its potential migration to the PTC and SCC, may not have been identifiable once the target assembly was completed and placed in the PTC.</p> <p>The most likely cause of the contamination found inside of the SCC following Shot 86 was a small quantity of radiological material present inside the bellows assembly volume. The source of this contamination is not definitively known and could have originated directly from the Shot 86 target, from the assembly glove boxes at the Device Assembly Facility (DAF), or the target fabrication glove boxes at LLNL's Superblock.</p>
NA--LSO-LLNL-LLNL-2009-0004	Building 298 Yard Bead Blaster Unit Footprint Contamination	<p>Situation incorrectly identified or represented resulting in wrong rule used.</p> <p>There are no specific written instructions for Health and Safety Technicians to barricade potentially contaminated areas that are not beryllium work areas while awaiting results.</p>
NA--LSO-LLNL-LLNL-2009-0005	Items Labeled "Contains Beryllium" Improperly Disposed	SC 4 event – No causal analysis included in report
NA--LSO-LLNL-LLNL-2009-0011	Beryllium Contamination Found in Newly Commissioned Bead Blaster in Building 298	SC 4 event – No causal analysis included in report
NA--LSO-LLNL-LLNL-2009-0013	110-Volt Power Line Severed During Concrete Cutting Activity in Building 481	SC 4 event – No causal analysis included in report
NA--LSO-LLNL-LLNL-2009-0015	Arcing Tabletop Laser in Building 179	There were no injuries or illnesses associated with this event. While there was a potential for an employee to receive an electrical shock, the exact quantification of this potential exposure is not known. Qualified electricians will perform testing to determine the actual potential for electrical shock.

## Performance Analysis of Events

OR Number	Title	Cause(s)
NA--LSO-LLNL-LLNL-2009-0021	Management Concern Regarding Material Processing	SC 4 event – No causal analysis included in report
NA--LSO-LLNL-LLNL-2009-0024	Site Landscaping and Event Preparation Management Concern	SC 4 event – No causal analysis included in report
NA--LSO-LLNL-LLNL-2009-0035	Improper Disposal of Hazardous Containers in Dumpster at Building 264	SC 4 event – No causal analysis included in report
NA--LSO-LLNL-LLNL-2009-0037	Management Concern - Fire Sprinkler Damaged in Building 581 Causing Water Discharge in Switch Yard 2	SC 4 event – No causal analysis included in report
NA--LSO-LLNL-LLNL-2009-0040	Building 132N Liquid Nitrogen Fill Station Leak	SC 4 event – No causal analysis included in report

These events met the decision rules for analyzing further based on having a point above the UWL in the control charts. However, the analysis of these events concludes that the causes of the events were dissimilar and the events in this reporting criteria group are not classified as recurring, and they will be taken off the Watch List.

Watch List ☐

Recurring ☐

Not Recurring ☒

### **10(3) – “Near Miss – A near miss, where no barrier or only one barrier prevented an event from having a reportable consequence.”**

Prior to October 2008, there were no occurrences of this type for ten months straight. The reasons for this are not discernable from looking at the data. Prior to October 2008, the most recent near miss occurrence was reported in November 2007.

In CY09 there were four “near miss” events reported. This is a decrease of 50% (4) from the previous report. These events occurred in February, March, June and August, with one event in each month.

All of these events were analyzed in the previous report.

The CY09 near miss events are as follows:

1. NIF Target Positioner Nose Cone Pivoted, Pinning Worker's Hand
2. LLNL Flatbed Truck Accident with DOE Rental Car
3. Non-Energized Electrical Cable Cut Without Proper Energy Isolation
4. Discovery of Modified Exterior 2nd Floor Hand Rail System at Building 432

In CY07, there was an average of 37 days between these events. In CY08, the average was 102 days. In this reporting period, CY09, the average was 48 days between events. After a relatively low period of reporting 10(3) near misses prior to October 2008, LLNL experienced a few months of increasing reports of this type. However, this trend did not continue past August 2009. There were no new events of this type since August 2009. This decrease in events and the

# Performance Analysis of Events

corresponding increase in days between events can be viewed as a positive, in that we have experienced fewer near misses than in the past.

Table 5, below, lists the occurrences that were reported using the 10(3) reporting criteria, and their primary causes.

**Table 5 – 10(3) “Near Miss” Occurrences and Associated Causes**

OR Number	Title	Cause(s)
NA--LSO-LLNL-LLNL-2009-0010	NIF Target Positioner Nose Cone Pivoted, Pinning Worker's Hand	<p>No calculations were found that documented the structural integrity of the ITIC connection to the TARPOS boom. In addition, when the rotation tool was removed, the plate was suddenly able to rotate which allowed the top pins to come out of their boom attachment holes and cause the ITIC tip to fall.</p> <p>Although the work permit and hoist permit are clear in defining key roles, in general, the work team did not function in this manner. The hand-off of work was not crisp or clearly defined.</p> <p>Also, while the SPA used for the rotation tool removal activity mentioned a fall hazard of the ITIC, the technician had his hand underneath the cone when the rotation tool was removed.</p>
NA--LSO-LLNL-LLNL-2009-0017	LLNL Flatbed Truck Accident with DOE Rental Car	<p>There are no guidance documents or procedures (other than the ES&amp;H Manual) in place regarding the control of traffic during deliveries. The workers were not given Directorate specific guidance when making deliveries using a flatbed truck and forklift.</p> <p>The driver of the truck initially looked to his right to check for oncoming traffic. However, when the driver started to back up, his concentration was focused on the left rear of the truck to avoid hitting a fence post. If the driver had checked his passenger side rear view mirror, immediately prior to backing up, he would have seen the rental vehicle coming behind the flatbed.</p> <p>Human Performance Indicators: Changes/Departure from Routine - An unfamiliar or unforeseen task or job site conditions that potentially disturbs an individual's understanding of a task or equipment status.</p>

# Performance Analysis of Events

OR Number	Title	Cause(s)
NA--LSO-LLNL-LLNL-2009-0027	Non-Energized Electrical Cable Cut Without Proper Energy Isolation	<p>The worker assumed the cable was safe instead of assuming the cable was hazardous.</p> <p>Administrative processes were insufficient to ensure identification of the hazard and prevent the cutting of a cable that could have been energized with hazardous voltages.</p>
NA--LSO-LLNL-LLNL-2009-0029	Discovery of Modified Exterior 2nd Floor Hand Rail System at Building 432	<p>The original design for the removable hand rail was not to current code requirements.</p> <p>The process to remove the hand rail was stopped before the lower rail bolts were removed and the upper hand rail bolts and brackets were left in an unsecured condition likely due to the worker being distracted from the task and failing to return to complete the task (note: This is speculation because the reason the handrail was not secured is not known).</p> <p>The removable handrail was not periodically inspected after the top hand rail bolts and brackets were removed to ensure it was secured.</p>

The events were analyzed for commonality of causes, and none were found that represent a recurring condition.

Watch List ☐

Recurring ☐

Not Recurring ☒

## Infrequent Events Analyzed Further

There were three events that did not meet the frequency criteria for analyzing in the report. Their reporting criteria did not occur more than three times in the 12-month period or do not occur with enough regularity as to be an obvious concern to management. However, the groups are of high impact, and further discussion is warranted. These events and the following analysis were presented in the previous report.

### Reporting Group 1, "Operational Emergencies"

#### OE (1) "An Operational Emergency not needing further classification, as defined in DOE 151.1A, Chapter 5, Paragraph 2."

There were two Operational Emergencies (OE) declared during the review period. Operational Emergencies require the filing of an occurrence report. This type of an occurrence is rare – The last two OEs prior to this review period were in August 2007.

## Performance Analysis of Events

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Both of the events were declared as a result of wildland fires at Site 300, during June 2009. One fire was a roadside vegetation fire that was caused by a fire emanating from off-site, probably a cigarette or other burning material tossed from a vehicle as it was traveling on the public road adjacent to the Site 300 boundary. The fire was extinguished in approximately 35 minutes, causing no damage to LLNL property, and burning approximately four to five acres of vegetation covered soil.

The other fire at Site 300 that prompted the declaration of an OE was due to unusually high winds at Site 300 causing a high voltage line from an LLNL utility structure (pole) to separate from its insulator. The line dropped to the ground, and the resulting arcing of the live wire started the grass to burn. This fire spread to approximately 2,200 acres, and spread to adjacent grassland offsite, but did not cause damage to any structures. Some fencing posts were charred as a result. The fire was contained after approximately three hours.

The root cause analysis for these events describes totally different causes, and do not represent a recurring condition.

Watch List ☐      Recurring ☐      Not Recurring ☒

### Reporting Group 2, “Personal Safety and Health”

#### Subgroup A(1) – “Occupational Illnesses/Injuries – Any occurrence due to DOE operations resulting in a fatality or terminal injury/illness.”

On June 26, 2009, LLNL experienced a vehicle-related fatality. LLNL’s most recent fatality occurred off-site (vehicle accident on a public highway) in July 2006.

A worker was using a Lab pickup truck to move office materials. Although there were no eye-witnesses to the actual accident, it was determined that the worker was not wearing his seatbelt, and presumed to be partially outside of the vehicle (driver’s door was open – it is presumed that he was looking at something at a low level in the vehicle), with the vehicle in reverse, when his foot slipped off of the brake and onto the accelerator pedal, causing to vehicle to rapidly move into reverse, hitting other vehicles in its path. The driver was ejected from the truck, and later died of his injuries. A root cause analysis was conducted by an Incident Analysis Committee convened for this purpose, as well as a DOE Type A accident investigation.

This reporting criteria was used only once in CY09. Therefore, the 2A(1) reporting criteria group is not considered to be recurring. However, the analysis of causes for this event and a determination of a recurring condition is included later in Section 4, Cause Code A3B1C03, “Human Performance LTA; Skill Based Error; Incorrect Performance Due to Mental Lapse.”

Watch List ☐      Recurring ☐      Not Recurring ☒



# Performance Analysis of Events

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## Below-ORPS (Site) Reportable Events

Site-reportable (SR) events or conditions are below the DOE reporting criteria threshold but are within the criteria established by agreement between LLNL and LSO. Site-reportable events or conditions are analyzed for potential recurring problems. In January 2006, LLNL began gathering site-reportable information, using a list of 13 areas agreed upon by the NNSA Livermore Site Office and LLNL. The below-ORPS groups and subgroups are listed in Appendix C.

The data was pulled from LLNL databases, such as Occupational Accident Injury/illness Analysis Support Information System (OAASIS), and the Sample Tracking and Reporting (STAR) database, or specific Functional Area Manager's logbooks. An individual directorate may report a site-reportable item as a single event or condition.

### Summary of Below-ORPS Reported Occurrences by Reporting Criteria Group

#### Group 2 – “Personal Safety”

##### Group 2A OSHA Recordable Cases

- 125 recordable cases (Medical treatment, restricted workday and days away cases)
  - One fatality (vehicle accident)
  - 20 days away cases, requiring 527 days away
  - 30 restricted workday cases, requiring 1,183 restricted workdays

##### Group 2B Measured Exposures

- 1 measured exposure exceeding an action level
  - These measured exposures were reported in the previous report

##### Group 2C Hazardous Energy Control Process

- There were 14 total electrical events
  - Six of these events were ORPS-reportable, and have been analyzed in the ORPS-reported occurrences
  - Seven of the events did not meet the ORPS-reportable or Site-reportable criteria
  - One event was Site-reportable as below-ORPS

##### Group 2D Fire

- Three fires that took less than 10 minutes to extinguish

#### Group 4 – “Facility Status”

There were six events that fall into this category:

##### Group 4A Performance Degradation of SSC

- One event was related to a performance degradation in a safety structures, systems or components (SSC)

# Performance Analysis of Events

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## Group 4C Violation of FSP/OSP/IWS or working without authorization

- Five events were related to working in violation of Facility Safety Plans, Operational Safety Plans or Integration Work Sheets/Safety Plans (FSP/OSP/IWS/SP), or working without proper authorization
  - Four of these events were analyzed in the previous report

## Group 5 – “Environmental”

- There were eight releases of water to the environment during the review period

## Group 6 – “Radiation”

- There were a total of 39 CAM (Continuous Air Monitor) alarms received in the review period.
  - No positive alarms
  - All alarms were from Radon sources
- There were no positive nasal swipe readings

## Group 8 – “Transportation”

- There were no transportation events reported during the review period

## Detail of Below-ORPS Reported Occurrences by Reporting Criteria Group

The results of the analysis for these events, where the functional managers provided data, follow.

### Below-ORPS (Site) Group 2, “Personal Safety”

#### **Group 2A, “Medical Treatment or Inpatient Hospitalization – Any single occurrence requiring medical treatment or inpatient hospitalization beyond first aid unless otherwise reported as a near miss.”**

The OAASIS database was queried for all recordable case data. The data is summarized as follows: There were a total of 125 recordable cases reported in OAASIS, for CY09. Of these cases, one was a fatality (vehicle accident), 20 (16%) resulted in 527 days away. 30 of the 125 cases (24%) required the employee to be transferred to another job or work with specific temporary restrictions for up to 1,183 days. Both the total number of days away and restricted days shows a decreasing trend from the previous report. Total days away for CY09 was 527, decreasing from 819 in the previous reporting period, October 2008-September 2009. Total restricted days decreased from 1,236 in the previous period to 1,183 days for CY09.

Injuries/illnesses related to strains, sprains, and musculoskeletal disorders, repetitive motion or overexertion, continue to be the most prominent, as has been shown over the years.

## Performance Analysis of Events

Although repeated types of injuries are evident, there has been no declaration, through analysis by the SME, that these cases constitute a recurring condition. These types of events or conditions will be further monitored to determine if any meet the ORPS reporting criteria.

Watch List ☒

Recurring ☐

Not Recurring ☐

### Group 2B “Measured Exposures – Measured exposures that exceed an action level, regardless of PPE used.”

All personal sampling data from STAR for CY09 was analyzed by the SME. The data query returned 4,412 results. All blank sample data was removed, as well as data identified as “personal” but no employee was named, and data for which there were analytical problems. This reduced the data set to 3,138 valid results. The overwhelming majority of these 3,138 samples were below the analytical laboratory’s reporting limit.

These results were then compared to the standards specified in 10 CFR 851, that is, 10 CFR 850, the 2005 ACGIH Threshold Limit Value (TLV®), or the current OSHA standards, 29 CFR 1910 Subpart Z, whichever was lower. The action level (AL) used was that specified in the appropriate standard, or 50% of the permissible exposure limit (PEL) or TLV, when there was no defined action level.

For those materials with several TLVs, e.g., copper (TLV for copper fume is 0.2 mg/m<sup>3</sup>, and copper dust and mists is 1 mg/m<sup>3</sup>), the lowest value was used for comparison.

The resultant data is presented in Table 6, and graphically in Figures 13 and 14.

**Table 6 – Results from Exposure Measurements**

Period	Number of Results			
	Total	Less than LOD <sup>1</sup>	Less than AL <sup>2</sup>	Above AL <sup>3</sup>
Jan - Mar 09	538	504	33	1
Apr - Jun 09	485	467	18	0
Jul - Sep 09	989	945	44	0
Oct – Dec 09	1,126	1,098	28	0
<b>Overall</b>	<b>3,138</b>	<b>3,014</b>	<b>123</b>	<b>1</b>

<sup>1</sup> LOD (Limit of Detection) is below the analytical laboratory’s reporting limit

<sup>2</sup> Less than AL (action level) is a result above the LOD, but below the AL

<sup>3</sup> Above AL is a result above the AL, but below the ACGIH or OSHA occupational exposure limit

## Performance Analysis of Events

Figure 13 – Number of Analytes Monitored for Personal Exposures

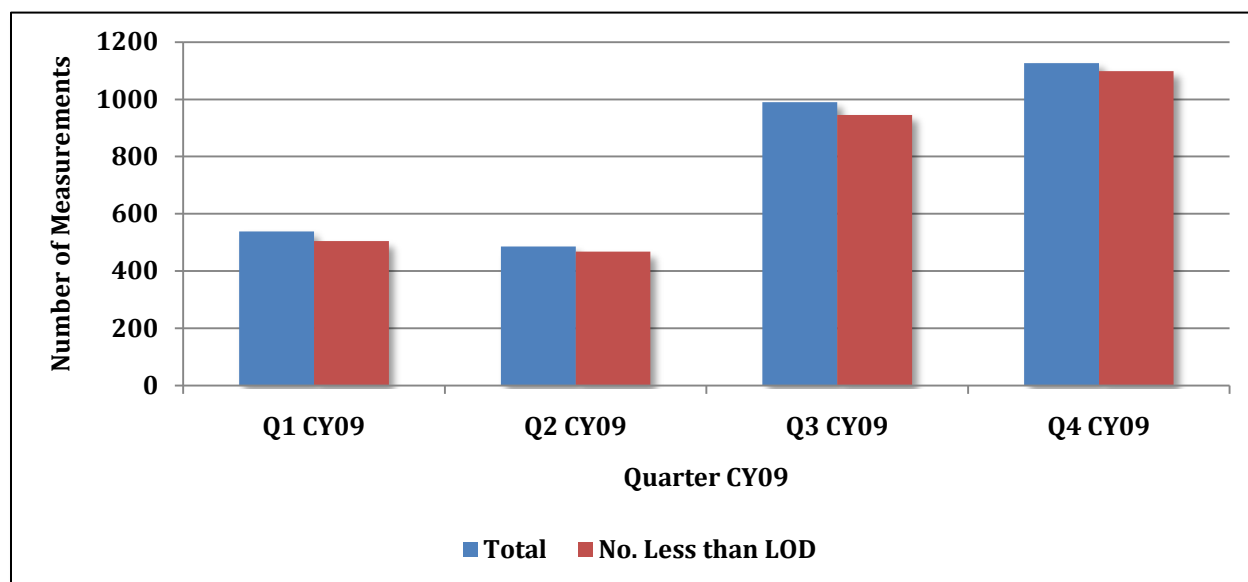
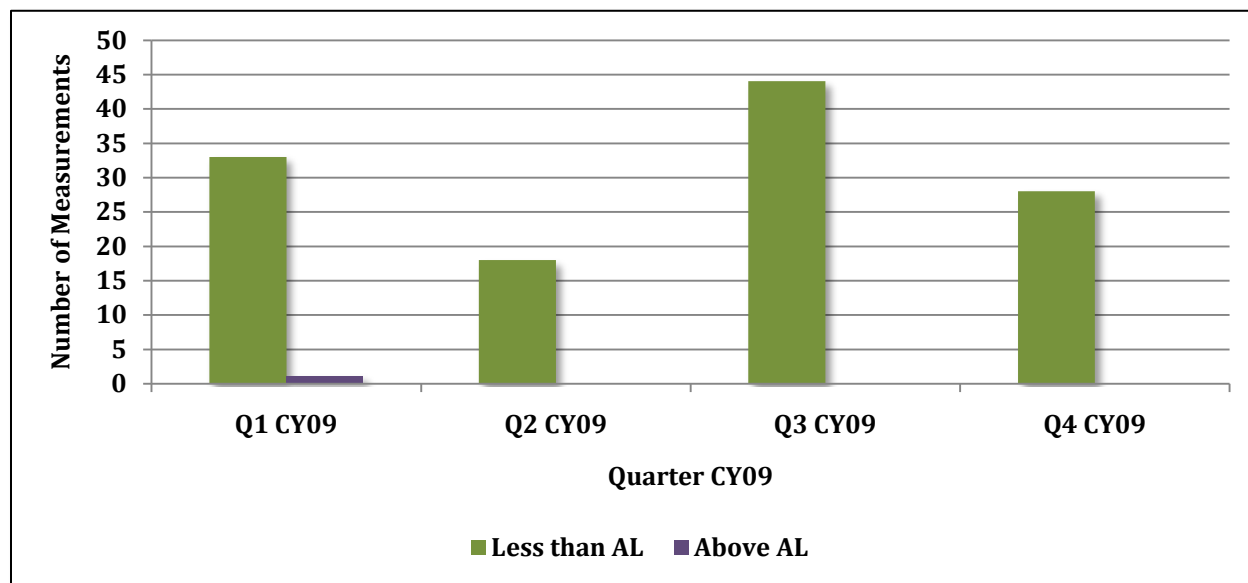


Figure 14 – Measured Results from Exposure Monitoring



### Beryllium samples

There were 1,238 beryllium personal sample results for the year. Of these, only twelve were above the analytical laboratory's limit of detection; the largest was 43% of the action level. Respiratory protection was used for all but 76 sampling events, and was used in all situations where beryllium was detected. There were no measured beryllium exposures in excess of the 10 CFR 850 action level in the CY 2009.

# Performance Analysis of Events

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## Exposure Above the Action Level

There was only one sample in excess of an action level (117% of 50% of the ACGIH TLV). Exposure was anticipated, thus the worker was in full body protective clothing with a full-face powered air purifying respirator. The respiratory protection was more than adequate for this limited exposure.

The remainder of the detected exposures were below their respective actions levels, and are of little to no concern.

Watch List ☐

Recurring ☐

Not Recurring ☒

**Group 2C “Hazardous Energy Control Process – A determination that the prescribed hazardous energy control process was not followed properly and one of the following conditions resulted:**

- **Discovery that additional equipment should have been controlled through the lockout/tagout even though the equipment was found in a safe state.**
- **Discovery that any equipment included in the lockout/tagout was not properly controlled (i.e., missing or non-effective lock), even though the equipment was found in a safe state.”**

Directorates are to provide information regarding potentially reportable “electrical”-related events to the Contractor Assurance Office/Performance Analysis and Reporting Section and to the electrical safety subject matter expert (SME) to determine ORPS reportability.

The electrical safety SME compares the information to the DOE “Electrical Severity Measurement Tool” developed for the EFCOG/DOE Electrical Safety Improvement Project. This tool determines the severity of an electrical-energy event based on an evaluation of a series of electrical factors. After applying the appropriate values to the formula, a score is generated. This score assists the Laboratory in determining if the event or condition is reportable in the DOE ORPS or site reportable. See Table 7, below, for the actual scores and associated ORPS significance category assigned.

The SME provides a quarterly report that identifies the number of cases and the score generated of events or conditions that meet the site-reportable criteria, including a summary of the impact the events had on the Laboratory.

# Performance Analysis of Events

**Table 7 - “Electrical Severity Measurement Tool” developed for the EFCOG/DOE Electrical Safety Improvement Project**

Example: Electrical Severity (ES) = (Electrical Hazard Factor) * (1+Environmental Factor + Shock Proximity Factor + Arc Flash Proximity Factor + Thermal Proximity Factor) * (Injury Factor) $ES = (10) * (1 + 0 + 10 + 0 + 0) * 1 = 110$		
Significance	Electrical Severity	ORPS Group 2 Significance Category
Extreme	3300	1 or 2
High	330 – 3300	3
Medium	30 – 330	4
Low	0 – 30	ORPS Non-Reportable*
*Requires evaluation under ORPS Group 10 Criteria, or, could be Site-reportable		

The SME tracked 14 electrical events. Six of these events met the criteria for ORPS reportability in the Group 2C criteria, and are discussed above in this report. Seven of the events did not meet the threshold for Below-ORPS reportability in that they were found in a safe state, and did not involve failures in the control of hazardous energy (Lock-out/Tag-out) procedures. One event did meet the criteria for Below-ORPS reportability, and is described as follows:

1. On October 16, 2009, after a morning tailgate meeting, GSE Electricians were to remove a 4-plex electrical box from the east side of room 1200, the high bay in Building 341. The 4-plex was de-energized according to LOTO procedures. The GSE electrician went to the designated breaker panel and found a circuit in the “on” position. Further investigation revealed energized outlets connected to this breaker. The workers followed the conduit from the panel box toward the work area and observed exposed but terminated energized conductors. GSE performed a LOTO at the panel on the live circuit and called a work pause to review the situation.

In this event, work was conducted according to proper LOTO procedures, however, there were live electrical conductors found in the work area, although they were safely terminated (capped), therefore meeting the criteria for Below-ORPS reporting.

This event illustrates the importance of following the proper LOTO procedures to identify hazards with stored energy. The workers applied the correct procedures, which allowed them to find the live conductors, stop the work, determine a path forward, and avoid injury. This was an isolated event, and does not represent a recurring condition.

Watch List ☐      Recurring ☐      Not Recurring ☒

# Performance Analysis of Events

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## **Group 2D “Fire – A fire that takes less than ten minutes to put out or a fire that disrupts operations in a moderate hazard facility”**

There were three events that meet this criteria:

1. On April 10, 2009, at the Small Firearms Training Facility (SFTF – “Rifle Range” at Site 300), a small grass fire was identified by range personnel. The Fire Department was notified via phone, and responded immediately to douse the smoldering weeds. There was no damage to facilities or threats to personnel. The cause of the fire was due to tracer ammunition fired into targets at the range. Weeds and dry brush surround the targets in this area. The tracer rounds were given to LLNL by Sandia National - Laboratory Livermore, to expend at the range, however, they were not identified correctly, and the shooters did not know they were using tracer ammunition. The tracers ignited the weeds and brush around the targets. There were no injuries during this event.
2. On May 25, 2009, a small grass fire was started on the banks of an arroyo on LLNL's main site as a result of grass mowing activity on the east side of the Lab. The Fire Department responded and put out the fire quickly, containing the burned area to approximately ten square yards.
3. On November 6, 2009, a worker using spot-welding equipment in Building 551 noticed a burning rag that he had placed on a nearby table. Upon investigation it was discovered that the rag had been placed on top of the spot-welder years earlier, and the worker removed it on this day, placing it on the table. A spark from spot-welding activity flew onto the rag, igniting it. The worker thought that he had extinguished the burning rag, and left the area to work elsewhere. Two other workers noticed a burning smell and discovered the smoldering rag. The rag was safely taken to the area sink where it was safely put out with water. The Fire Department was not contacted in this instance.

These events do not have similar causes, and do not represent a recurring condition.

Watch List ☐      Recurring ☐      Not Recurring ☒

## **Below-ORPS (Site) Group 4, “Facility Status”**

### **Group 4A “Performance Degradation/Actuation of Credited Safety Structures, Systems, and Components (SSCs) – Performance degradation/actuation of credited safety structures, systems, and components (SSCs) in non-nuclear facilities that prevents satisfactory performance of its design function when it is required to be operable.”**

There was one event that meets this criteria in the review period:

1. On February 2, 2009, it was reported that the boiler in Building 365 that serves the autoclave wasn't functioning. The FPOC decided to have Plant Engineering perform work on the boiler, rather than the company that was contracted for the boiler

## Performance Analysis of Events

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maintenance and autoclave certification. On February 13, 2009, Plant Engineering, while troubleshooting the boiler's systems, discovered that the high water sensor (which is part of a "safety train" that acts in concert to alarm or shut down the boiler if unsafe conditions are encountered) was wrapped in Teflon tape, defeating the sensors ability to sense the water level. It is not known how long this condition existed. The boiler was tagged out of service until the sensor was replaced and the other safety systems checked.

This event is of concern because LLNL has experienced similar events in the past. In September 2008, LLNL's Independent Audit and Oversight Department issued an assessment report entitled "Boiler Safety Controls Assessment." The assessment was prompted by an employee's safety concern and focused on inspection, testing and maintenance for boilers used to heat buildings at the Livermore site, and for boilers at the National Ignition Facility (NIF). The assessment report lists 14 findings, two concerns and three opportunities for improvement (OFI).

One of the events cited in the report was forwarded by an employee with a safety concern. The concern alleged a modification to a boiler low-water cut-off, reportedly made in 2002 by a subcontractor, instead of by LLNL's Plant engineering personnel. Rather than correct the condition that was making the boiler malfunction, the subcontractor reportedly made an unauthorized modification that effectively bypassed the low-water level safety control.

As a result of the audit report, LLNL implemented corrective actions to address the causes listed in the report.

The conditions leading to this event have been identified through the assessment process, and are the subject of a Noncompliance Tracking System (NTS) report. They are not considered to be recurring.

Watch List ☐      Recurring ☐      Not Recurring ☒

**Group 4B "Life-Safety Equipment – Life-safety equipment (not designated as safety class or safety significant) is inoperable for an extended period of time (more than the time it would take to properly repair)"**

There were no events reported during the review period.

Watch List ☐      Recurring ☐      Not Recurring ☒

**Group 4C "Safety Controls – Violation of safety controls in facility safety plans (FSPs), operational safety plans (OSPs) or Integration Work Sheet/safety plans (IWS/SPs), including working without proper authorization"**



# Performance Analysis of Events

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There were five events reported during this review period:

1. On May 7, 2009, the Physical and Life Sciences Directorate management was made aware of a training deficiency pertaining to the operation of the Explosives Waste Treatment Facility (EWTF) and Explosives Waste Storage Facility (EWSF). The California State Department of Toxic Substances Control (DTSC) permits these facilities. The existing permit is in the process of being revised and one of the changes pertains to the repeat frequency for the LLNL course HS2016 "Explosives Safety Orientation." The current permit stipulates an annual repeat frequency, while the draft new permit requires only a three-year refresher. Due to confusion between the two versions of the permits, eight workers were found to be six months non-compliant with training. The permit conditions form the basis for controls included in these LLNL safety documents.
2. On June 16, 2009, a worker opened an unmarked drawer in Building 362, R105 (a Radioactive Materials Area), and discovered a high performance liquid chromatography injection port that contained a radioactive trefoil label. Surveys and swipes confirmed that there was contamination on the injection port itself, but not on any of the surfaces of the drawer. There was no loss of radioactive material, no spread of contamination off of the injection port, and there was no personnel contamination.
3. On July 7, 2009, in Building 132N, there was a discrepancy noted on high explosive storage. Specifically, the Facility Safety Plan (FSP) identified an administrative limit of 25 grams per repository drawer in Room 1901. Labels on the drawer and discussions in the IWS(s) state 50 grams. Additional information revealed that the FSP was modified in 2006 - Changes to formatting and how the limits were presented resulted in an inadvertent change to the limits. A discussion with the researchers and the explosives safety engineer confirmed that there was no safety driver behind this change and that the 50 gram limit should have been retained.
4. On July 9, 2009, a pencil sharpener was discovered mounted to an electrical enclosure containing 120/208V electrical power in a Building 543 server room. The area was immediately barricaded and MUSD Electricians responded to investigate the situation. Upon donning the appropriate electrical PPE, the electrician opened the electrical cabinet and found that the self tapping screws used to mount the pencil sharpener had penetrated the electrical enclosure. Work was immediately stopped, the room was administratively restricted, and a method to resolve the situation of compiled. The feeder cables were inspected, with minor damage noted to the insulation on one of the cables. The suspect screws were removed and the cable was repaired. Building 543 occupants were questioned as to when the pencil sharpener had been mounted and no accurate information could be retained. The LLNL electrical safety SME was consulted in response to this event. No injuries or impacts to facility operations resulted in discovery of this situation. An LLNL Safety Alert was generated in response to this incident.
5. On October 9, 2009, two MUSD maintenance mechanics transferred sodium nitrite from a 55-gal drum used for bulk storage to 2-gal containers that were easier to handle. They emptied one 55-gal drum that night and had another drum that was previously emptied.

## Performance Analysis of Events

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They loaded the two empty drums into a truck for disposal and searched for a dumpster onsite that had adequate capacity to accommodate the 2 drums. The drums were improperly placed into a dumpster near Building 264. The MUSD maintenance mechanics have recently taken over responsibility for chemical treatments for heating and chilled water systems from the Instrument Shop. These drums were the first batch of chemicals ordered by the maintenance mechanics. The two 55-gallon drums were improperly placed into the dumpster and should have been handled by other means per the requirements of the State of California. The drums were correctly discovered/identified by other Laboratory employees, removed from the dumpster and correctly managed by the onsite waste disposal services.

In the first event, disparities between the existing and draft permit created confusion and subsequent training delinquencies for some workers. In the second event, a radioactive material under reporting limits was found inside a drawer – it was not determined how it got there. In the third event, an FSP was changed without a resulting change made to equipment affected by the FSP (limits on explosives in drawers). In the fourth event a “legacy” installation of a device’s mounting screws on an existing electrical enclosure could have contacted live parts inside the enclosure. It has not been determined when the installation of the pencil sharpener occurred, or if proper LOTO procedures were followed during the installation. However, the resultant condition of unprotected sharp items (screws) inside the cabinet is an obvious hazard that required correction. In the fifth event, workers discarded empty drums into a dumpster, in violation of existing procedures. It was determined that they were unaware of the proper procedures, and were counseled and retrained. This was an isolated event.

These events do not indicate a recurring condition. The cause(s) of some of the events have not been determined, and the other events do not share common causes. Although there do not seem to be shared common causes among these events, two of the events (#1 and #5) indicate that there may be a lack of understanding relative to environmental permits or requirements. We will place this below-ORPS criteria on the Watch List and monitor it for events included in the next report.

Watch List ☒

Recurring ☐

Not Recurring ☐

### **Below-ORPS (Site) Group 5, “Environment”**

#### **Group 5A “Unauthorized or Accidental Release – Unauthorized or accidental releases (reported to state and local agencies by the Environmental Protection Department) that do not meet the DOE ORPS reporting criteria”**

During this review period there were eight below-ORPS reportable events regarding environmental releases:

1. On February 10, 2009, approximately 2,400 gallons of chlorinated potable water flowed from a broken water line across a lawn and into a storm drain where it mixed with treated

## Performance Analysis of Events

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ground water discharge and likely flowed into the arroyo and offsite at the northwest corner.

Direct cause(s) determination by F&I: This event occurred south of B482 and was attributed to the fact that a tree was planted over a pipeline. The roots from the tree impacted the pipeline to the point which caused it to break. The F&I MUSD dig permit process should help to minimize this dynamic in the future

2. On May 25, 2009, fire-fighting water from extinguishing a small grass fire on the banks of an arroyo on LLNL's main site entered the arroyo. Fire-fighting water is an authorized non-storm water discharge per LLNL Storm Water Pollution Prevention Plan, but because it may have contained sediments or burned materials and likely went off-site, LLNL notified the regulatory agency and counted it as a release.

Direct cause(s) determination by F&I: F&I does not consider this to be an issue. The water discharge associated to any fire fighting emergency is an acceptable risk as it relates to the fact that water is used to preserve the safety of LLNL employees and property.

3. On July 5, 2009, the housing on the in-line filter in a chlorinated potable water line leading to an icemaker broke and an estimated 20,000 gallons of water was released and flowed to a storm drain where it then flowed to an on-site drainage basin (Lake Haussmann). The basin flows to an arroyo and the water could have flowed off-site. The area of the release is not known to be contaminated and there is no reason to suspect that the drinking water contained reportable quantities of chemical constituents. Since the water may have gone off-site, LLNL reported the release to the regulatory agency as required.

Direct cause(s) determination by F&I: F&I/MUSD line management was not made aware of this event

4. On September 20, 2009, a pipe on a ground water treatment unit burst and released approximately 3,360 gallons of untreated water containing a total of 1.3 grams of volatile organic compounds. At least some of the water reached a storm drain.

Direct cause(s) determination by F&I: Water treatment units are not maintained under the Maintenance & Utilities Department. Water treatment units are installed and maintained by criteria set by the Environment Restoration Department.

5. On September 21, 2009, in response to reports of intermittent water discharge at Site 300, digging uncovered a clay pipe about four feet below grade. The pipe was discovered to be coming from a washing machine that typically discharges to a sewage evaporation pond.

Direct cause(s) determination by F&I: This system was attributed to historical piping whose configuration was not fully known to the site, the system was considered acceptable, until this event when it was discovered. Once discovered, the system configuration was repaired correctly.

## Performance Analysis of Events

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6. On October 2, 2009, a water main under First Street broke and released approximately 18,000 to 20,000 gallons of potable water that flowed to a storm drain connecting to the Arroyo Las Positas. Water flow in the storm drain may have mixed with treated groundwater discharges from the site and flowed off-site. The drinking water discharge did not come into contact with areas of known soil contamination. Because the discharge exceeded the 10,000-gallon threshold for clean water discharges to uncontaminated areas, it was reported as required to the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB).

Direct cause(s) determination by F&I: This water line break more than likely was the result of ground settling due to heavy loads atop the roadway, a dynamic that can neither be eliminated nor prevented.

7. On November 30, 2009, an irrigation valve malfunctioned over the Thanksgiving holiday, releasing water at a rate of about 50-gallons per minute until the leak was discovered and stopped on Monday morning. An estimated 252,000 gallons of potable water flowed into the LLNL storm drain system to a dry sediment retention basin on-site. There was no indication that the water flowed past the basin. The release was reported to the SFRBWQCB in accordance with LLNL's Industrial Storm Water Permit (95-174) and Storm Water Pollution Prevention Plan (SWPPP), as a "Low Impact/Nuisance" category.

Direct cause(s) determination by F&I: This event was the result of a failed irrigation valve. LLNL plans to install "smarter meters" on water systems throughout the site may eliminate discharges such as these in the future.

8. On December 15, 2009, a release of coolant water from the roof of Building 253 was discovered in the afternoon. Due to safety concerns and a moratorium on roof access at the Livermore site, the air conditioner leaking the coolant was not accessed and turned off until the next morning. The leak is estimated to have released 1,230 to 2,460 gallons of water consisting of potable city water with a sodium nitrate inhibitor. The water reached a storm drain that flows to the Arroyo Los Positas, a distance of about 3,000 ft. A downstream discharge of treated ground water into the same storm drain, along with a small amount of rainfall, is conservatively estimated to have caused a dilution factor of 37 to 60 times before the discharge reached Arroyo Los Positas where it would have blended with the flow in the Arroyo, resulting in another dilution of approximately 600 to 1,200 times before flowing off-site. This release was reported to the SFRWQCB, as a "Low Impact/Nuisance" release.

Direct cause(s) determination by F&I: This event was the result of a system malfunction exacerbated by safety measures imposed by the Facility Management Department.

For these events, it is possible that some of the water was chlorinated and/or contained sediments that were in the run-off to other areas. It was determined, however, that the impact to the environment was not considered to be of concern.

Six of the eight events described above represent failed or malfunctioning facility equipment and/or infrastructure, and will require a detailed analysis by knowledgeable personnel to

## Performance Analysis of Events

determine causes. The F&I directorate is participating in analyzing these events to determine the most likely causes. The results of a common cause analysis will be included in the following report.

Due to the number of releases, and the similarity of the events such as broken water lines/pipes or failed equipment, and the on-going causal analysis being conducted by F&I, the Below-ORPS Group 5A will remain on the Watch List for analysis in the next report.

Watch List ☒

Recurring ☐

Not Recurring ☐

### Below-ORPS (Site) Group 6, “Radiation”

#### Group 6A “Radiation CAM Alarm – Any continuous-air-monitor (CAM) alarms from breathing air from airborne radioactivity”

There were a total of 39 CAM alarms reported in the review period. Of these, none were positive CAM alarms. The 39 alarms were radon alarms. The number of radon alarms fluctuates throughout the year based on natural conditions. See Table 8, below, for the alarm breakdown.

**Table 8 - Reported CAM Alarms**

CY 2009 Quarter	Positive CAM alarms	Radon Alarms	Other Alarms
1	0	14	0
2	0	5	0
3	0	10	0
4	0	10	0

The SME’s analysis of the data does not suggest a recurring problem.

Watch List ☐

Recurring ☐

Not Recurring ☒

#### Group 6B Nasal Swipes

“Number of nasal swabs where the combined activity is >10-dpm alpha.”

There were no nasal swipes taken where the combined activity exceeded 10-dpm alpha. See Table 9, below.

**Table 9 - Nasal Swipes by CY Quarter**

CY 2009 Quarter	Nasal Swipes >10-dpm alpha
1	0
2	0
3	0
4	0

## Performance Analysis of Events

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An analysis of the data does not suggest a recurring problem.

Watch List ☐      Recurring ☐      Not Recurring ☒

### **Below-ORPS (Site) Group 8, “Transportation”**

**Group 8A “Accident Involving Hazardous/Radiological Material or Explosives – Any accident involving a vehicle carrying hazardous/radiological material that is not otherwise reportable”**

There were no reports generated during the review period.

Watch List ☐      Recurring ☐      Not Recurring ☒

**Group 8B “Violations of LLNL Requirements – Any violation of LLNL requirements involving onsite transportation of explosives”**

There were no reports generated during the review period.

Watch List ☐      Recurring ☐      Not Recurring ☒

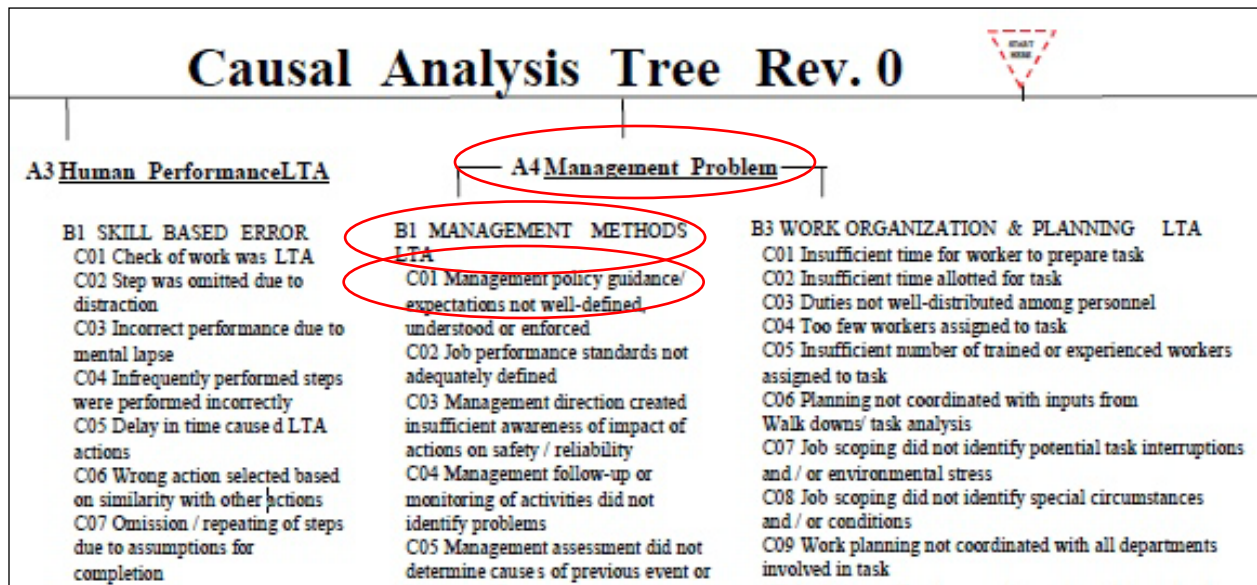
# Performance Analysis of Events

## 4.0 Analysis of Recurring Patterns Including Causes

DOE requires sites to assign “cause codes” from the Causal Analysis Tree (CAT), described in DOE Guide 231.1-2, to the causes identified in the analysis of ORPS-reported occurrences. Causal codes are typically not assigned to the data or the analyses done for Below-ORPS reportable events. The Causal Analysis Tree (CAT) was developed to assist in coding causes for all occurrences. These codes are useful in organizing occurrence causes for further analysis. The cause codes can be applied to the results of both root cause and apparent cause analysis.

A portion of the CAT is shown in Figure 15, below. The highest level of the CAT is the “A” level. After choosing one of the seven “A”-level categories, a “B”-level category and a “C” level cause are selected. The combination of the three levels constitutes the “cause code.” For example, if the analysis of the occurrence determines that a lack of policy guidance was a cause for the event, we would select “A4 (Management Problem), B1 (Management Methods LTA), C01 (Management policy guidance/expectations not well-defined, understood or enforced).” The resulting cause code would be “A4B1C01.”

Figure 15 - Portion of Causal Analysis Tree from DOE G 231.1-2



## Method

The Pearson correlation test was used to measure the relationship between each cause code selection, by A-level of cause code. The review for recurring occurrences was done in two ways, a quantitative data analysis and a qualitative analysis:

- (1) Quantitative Data Analysis: Occurrences were examined by reviewing all causal codes (including all three levels), selected more than once for the same principle directorate and actions taken for each occurrence. If the same causal code was used for similar

# Performance Analysis of Events

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occurrences (same reporting criteria), the causes were examined to determine if a common cause can be identified, and if a recurring situation exists.

- (2) Qualitative Analysis: Occurrences sharing like reporting criteria or causal codes were screened for recurrence using several different methods – trend by reporting criteria, trend by causal codes, and trend by narrative comparison. Report narratives are compared for similar themes and, when found, their causes are reviewed to look for trends. Causes pertaining to one directorate's occurrence, although perhaps similar on the surface, may not indicate similar causation in another, due to slight differences in the occurrences and programmatic work practices.

It should be noted that even when occurrences share like reporting criteria or causal codes, it is possible that the events are so dissimilar as to preclude them from becoming a trend in that area.

## Results

The most frequent A-level causal codes selected for this review period was A3, "Human Performance LTA," and A4, "Management Problem." The breakdown by percentage for the A-level cause codes is shown in Table 9.

Three combinations of A-level nodes were significantly, positively correlated:

1. "Design/Engineering Problem" (A1) and "Human Performance Less than Adequate LTA" (A3)  
[rho = .34 and p-value = 0.03]
2. "Communication LTA" (A5) and "Training Deficiency" (A6)  
[rho = .42 and p-value = 0.01]
3. "Training Deficiency" (A6) and "Other Problem" (A7)  
[rho = .48 and p-value = 0.002]

In the previous report, there were two combinations of codes that were significantly, positively correlated:

1. "Management Problem" (A4) and Design/Engineering Problem (A1)
2. "Design/Engineering Problem" (A1) and "Human Performance Less than Adequate (LTA)" (A3)

As we have historically seen, the A3 "Human Performance Less than Adequate (LTA)" codes were not chosen as the first code most frequently. They are chosen as "couplets" for other codes, such as the A4 "Management Problem" codes.

It is interesting to note that the A4 "Management Problem" codes were not chosen as often for the CY09 events. As can be seen in Table 9, these events represented only 37% of the codes, compared with 47% from the previous quarterly report, and 50% for the quarterly report before that. This decline in using the A4 codes as frequently (10% decrease from the previous report) is a result of the



## Performance Analysis of Events

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decrease in the number of reports identifying a management problem as often as previous reports. The A4 codes are still chosen more frequently than others, however, for CY09, the number of events where “less than adequate management of the work” decreased.

Also, for CY09, the A3 “Human Performance Less than Adequate (LTA)” codes were not associated positively as the first causal code. This is significant in that it points to fewer events being caused primarily by human factors directly.

**Because in this report we are analyzing most of the same events as the previous quarterly report, the percentages in distribution of the A-level cause codes are similar to the previous report. The distribution of the A-level cause codes is discussed below and in depicted in Table 10, below.**

The A4 cause codes were chosen at a significantly lower rate of 37% than the previous report (47%).

The A3 codes were applied at a slightly higher percentage (37%) than the previous reporting period, 36%

The A5 cause codes remained at the same frequency at 19%.

The A2 cause codes showed a slight increase in frequency for this period, as did the A1 and A7 codes.

The A6 codes showed marked decrease from the last report, at 2%, compared to 8% in the previous report.

The overall distribution of codes during CY09 seems to be spreading more evenly between the A-level code groups, as no single code group is presenting itself more often than others, compared to previous reports – the trend in CY09 is for the codes to even out, instead of one group being dominant. Of course, the largest percentage of the A-level codes are still being assigned to the A4 “Management Problem” and A3 “Human Performance LTA” codes, as seen in previous report. It appears as though this trend may be lessening.

The percentages of the various cause codes assigned fluctuate in every reporting period. This variation can best be explained by the number of events that are the same in each report, versus those that drop off the analysis due to the advancing 12-month review period.

# Performance Analysis of Events

**Table 10 - A-Level Cause Frequency**

Cause Code Level A Nodes	Description	% Selected
A4	Management Problem	37%
A3	Human Performance LTA	37%
A5	Communication LTA	19%
A2	Equipment/Material Problem	17%
A1	Design/Engineering Problem	12%
A7	Other Problem	10%
A6	Training Deficiency	2%
NOTE: Total Percent is greater than 100% since more than one code can be selected per OR.		

## Cause codes chosen more often than others across LLNL

Three cause codes (A4B1C01, A3B1C03 and A3B2C05), out of 167 from which to choose, were selected 13 times across LLNL, in events during CY09. They were chosen more frequently than other codes. Cause codes selected three or more times across the Lab are listed by principle directorate in Table 11. The A4B1C01 code was the most selected codes in the previous report as well – this is due to most of the same events being analyzed in this report. The most frequent cause codes selected, A4B1C01 and A3B1C03 are discussed further, below.

**Table 11 - The Most Common Causes of Occurrences During CY09**

Results for this Quarter			
Cause Code	Description	PAD	Frequency
A4B1C01	Management Problem Management Method LTA Management policy guidance/expectations not well-defined, understood or enforced	Lab-wide	5
		DO	0
		GS	1
		NIF	1
		O&B	1
		S&T	1
		WCI	1
A3B1C03	Human Performance LTA Skill Based Error Incorrect Performance Due to Mental Lapse	Lab-wide	5
		DO	2
		GS	0
		NIF	0
		O&B	1
		S&T	2
		WCI	0
A3B2C05	Human Performance LTA Rule Based Error Situation incorrectly identified or represented resulting in wrong rule used	Lab-wide	3
		DO	0
		GS	0
		NIF	2
		O&B	0
		S&T	0
		WCI	1

## Performance Analysis of Events

### Cause Code A4B1C01, “Management Problem; Management Method LTA; Management policy guidance/expectations not well-defined, understood or enforced”

Of the three most-selected cause codes used during the review period, the A4B1C01 cause code was chosen five times during the review period. The events are listed below, in Table 12.

This code was chosen as the first cause in three out of five events. It was listed as the second cause in two of the five events. In these two events, it was listed as a couplet code for an A3 “Human Performance LTA” code.

**Table 12 – Cause Statements for Occurrences With A4B1C01 Cause Code by Report Number**

Report No.	Title	A4B1C01 Cause Statement
2009-0006	Unauthorized Work On Lighting Switch In Building 453 Office	“Management expectations of only performing work within the employee's authorized work scope was not clearly acknowledged by the employee.”
2009-0017	LLNL Flatbed Truck Accident with DOE Rental Car	“There are no guidance documents or procedures (other than ES&H Manual) in place regarding the control of traffic during deliveries.”
2009-0018	Management Concern over Building 695 Operations	“Even though facility management has been trained on the Occurrence Reporting process as well as the USQ Process, they had wanted to wait on the results from the IA prior to filing the PISA or TSR violation, which is contrary to the training they had received.”
2009-0020	On-Site Procedures Not Followed in Movement of Radiological Material	“The root cause for this event was determined to be the lack of a clear, documented process governing the transfer of forensics evidence within LLNL and to offsite locations by exempt government agencies.”
2009-0027	Non-Energized Electrical Cable Cut Without Proper Energy Isolation	“Administrative processes were insufficient to ensure identification of the hazard and prevent the cutting of a cable that could have been energized with hazardous voltages.”

The A4B1C01 cause statements for the events listed above indicate that management’s control of the work through procedures, practices, policies, controls, and/or processes was insufficient to prevent the event. These events indicate a breakdown in the work control process, at the local principle directorate level, but do not indicate an institutional problem that would necessitate a recurring occurrence report.

# Performance Analysis of Events

At the institutional level, work control requirements in the form of policies and procedures exist that require management to thoroughly analyze the work hazards, develop controls and approve the work at all stages. For these events, the requirements for proper work control were inadequate.

Watch List ☐

Recurring ☐

Not Recurring ☒

## Cause Code A3B1C03, “Human Performance LTA; Skill Based Error; Incorrect Performance Due to Mental Lapse”

Table 12 below, shows the events in CY09 where management selected the A3B1C03 cause code. In four out of the five events listed, the A3B1C03 cause code was chosen as the first or primary cause of the event, indicating that the event was caused primarily due to the individual knowing the appropriate action(s) to take, but failing to initiate the correct action(s) based on inattention/over-attention.

In the last event in Table 13, the A3B1C03 code was chosen as the second cause, after another A3 cause code (A3B3C06 – “Human Performance Less Than Adequate; Knowledge Based Error; Individual underestimated the problem by using past events as basis”). In this event, the primary cause was determined to be that the individual was thought they were performing the correct action, but was using past events as a model for those actions, which turned out to be incorrect based on the actual conditions found in the workplace.

**Table 13 – A3B1C03 Cause Code by Report Number**

Report No.	Title	A3B1C03 Cause Statement
2009-0014	Worker Fractures Ankle After Stepping Off Paved Path Near Building 271	“The employee "cut" the corner. In doing so, the employee stepped off the paved pathway. The employee did not maintain full awareness of footing when walking on pathway.”
2009-0022	Worker Sustains Ankle Fracture After Slipping Off Curb While Entering Vehicle In Parking Lot South of Building 661	“This injury occurred because the employee chose to park too close to the curb/landscape island...This resulted in her having to walk on the curb/landscaped island to access the driver's side of her vehicle. The curb and island configuration presented an uneven walking path. She did not recognize this as a hazard when she parked the vehicle, and when she returned to the vehicle to get in, not having an increased awareness because of the presence of a new hazard (uneven walking path), she did not alter her behavior accordingly...”

## Performance Analysis of Events

2009-0028	On Site Vehicle Accident by Building 242 Results in Fatality	<p>“Because there were no direct witnesses to the incident, and with only limited physical evidence, it was not possible for the Incident Analysis committee to determine with any certainty what occurred at the time of the incident. While recognizing other reasonable scenarios could be proposed, the committee developed a reasonable, but hypothetical, scenario based on the available evidence.”</p> <p>[Note - The committee believes that the worker removed his seatbelt (after shifting the vehicle into reverse) opened the door to release the parking brake – this left the worker vulnerable to ejection from the vehicle when it suddenly moved to the rear.]</p>
2009-0031	Worker Sustains Fracture After Losing Control of Laboratory Bicycle	<p>“The worker was riding too closely to the bike in front of her so that the only choices left when the lead bicycle stopped suddenly were to run into the other bicycle or go off of the path.”</p>
2009-0034	Worker Receives Electric Shock When Finger Enters Into Broken Light Switch Casing in Building 235 Kitchen	<p>“The switch was likely broken as a result of human interaction (e.g., the switch was flipped by a worker and it broke, or the switch was impacted by a tool or piece of equipment being handled by a worker and it broke). The worker did not report it for repair or replacement.”</p>

The cause statements listed for the A3B1C03 events listed above illustrate how human interaction with our immediate environment influences the choices we make and the steps we either take or fail to take in accomplishing a task. While it is sometimes easier to put the bulk of the cause(s) on the worker for any given event, the analysis must dig deeper in order to fully comprehend the nature of the event and the reason(s) why the worker does the things they do, that lead to an event.

Occurrence number 2009-0028, the June 2009 vehicle fatality, in Table 12, above, was caused in part by incorrect performance due to mental lapse.” The Incident Analysis Committee concluded that the root cause of this incident was operator error. The committee also determined that human factors likely played a role in the initiation of the incident. The JONs, as determined by the committee, are as follows:

1. LLNL management should take action to improve compliance with LLNL policies that require the use of seat belts. Emphasis should be placed on the need to have the seat belt

# Performance Analysis of Events

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fastened before turning on the vehicle or, if not possible because of vehicle design, before engaging the gearshift.

2. LLNL should conduct an evaluation of past accident data to better characterize both the rates and nature of the accidents that are occurring. Depending on the outcome of this evaluation, LLNL should take effective action to address any issues that are identified.

The DOE Type A accident investigation concluded that the root cause of this event was that the vehicle safety features were not used by the employee. A contributing cause was the employee's unfamiliarity with the operation of the vehicle. The LLNL JONs, as determined by the board are as follows:

1. Improve the safe driving behavior of the site workforce.
2. Improve the selection process for general-use fleet vehicles.
3. Familiarize the workforce with vehicle safety features of the fleet
4. Develop and implement procedures to ensure effective accident scene management.

Driver awareness, familiarity with general-use vehicles and use of the vehicle's safety equipment are the areas where LLNL needs to focus and improve in order to prevent this type of event from happening in the future. A formal corrective action plan has been submitted to DOE, and subsequently approved, for the JONs.

In February 2010, LLNL experienced an event with similarities to the June 2009 vehicle fatality (LLNL-2010-0009, "Unexpected rolling Truck Near Miss"). Although the final occurrence report for the February 2010 event has not been completed as of the date of this report, a root cause analysis was conducted and the committee's report has been finalized. There is sufficient common cause between these two events to declare the events recurring and a recurring occurrence report is in development. The following report will contain the details of the analysis and the recurring report.

Watch List ☐      Recurring ☒      Not Recurring ☐

## Analysis of specific cause code combinations

The quantitative analysis of the occurrence report cause codes revealed several combinations of codes being selected for different events, by the same principle directorate. The list of combinations is reviewed and cross-referenced (cross-cutting) with similarly coded events during the qualitative analysis to determine which combinations of codes/occurrences should be discussed in this report for possible common causes and recurring conditions.

The result of this cause code/occurrence crosscutting technique yielded two common cause codes where the principle directorate selected the same cause code for more than one occurrence. They are presented below in Table 12, and are discussed further. When the cause codes have previously been analyzed, they are indicated.

# Performance Analysis of Events

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1. **Cause Code A3B1C03, "Human Performance LTA Skill Based Error Incorrect Performance Due to Mental Lapse"**
  - **Directors Office, OR 2009-0014 and OR 2009-0022**
  - **Science & Technology, OR 2009-0028 and OR 2009-0031**
2. **Cause Code A5B4C01, "Communications Less Than Adequate (LTA); Verbal Communications LTA; Communication between work groups LTA"**
  - **Weapons & Complex Integration, OR 2009-0025 and OR 2009-0036**

The two cause code combinations listed above were individually analyzed as discussed in the methods section and the results are discussed below.

1. **Cause Code A3B1C03:** Directors Office, OR 2009-0014 and OR 2009-0022 [Analyzed in the previous report] & Science & Technology, OR 2009-0028 and OR 2009-0031

# Performance Analysis of Events

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## **OR 2009-0014 and OR 2009-0022:**

In these two events, reported under reporting criteria 2A(6), the common cause was identified as A3B1C03, “Human Performance LTA/Skill based error/Incorrect performance due to mental lapse.”

In the first event, a Protective Services Officer (PSO) fractured an ankle while walking on a paved walkway after coming off shift. The officer was carrying a box of personal items and did not have a good view of the walking surface. It was determined that the officer veered off the walkway and into the dirt alongside it, rolling an ankle and falling to the ground.

In the second event, a worker was approaching their vehicle parked in a parking lot that had curbing next to landscaped areas. It was determined that the vehicle was parked too close to one of the curbs, not allowing enough room for a person to walk between the vehicle and the curbing. The worker attempted to walk on the raised curb next to the vehicle, and due to the uneven surface, the worker slipped off the curb. It was later determined that the worker had sustained a hairline fracture in the right ankle.

The first occurrence was due primarily to not having clear “eyes on path.” The second event was caused by not recognizing a specific hazard (uneven walking surfaces). These two events had similar outcomes, but did not have similar causes. This is not a recurring condition.

## **OR 2009-0028 and OR 2009-0031:**

In these two events, reported under reporting criteria 2A(1) and 2A(6), the common cause was also identified as A3B1C03, “Human Performance LTA/Skill based error/Incorrect performance due to mental lapse.”

In the first event, it is believed that a worker influenced by their environment (in this case, not being able to see the parking brake release lever) altered their behavior in a way that defeated a barrier (removing their seatbelt). This action allowed other hazards present to interact with the worker, causing the fatality. The worker’s focus and attention was applied to a different task (finding then releasing the parking brake) instead of the main task (controlling the vehicle that was in reverse and ready to move).

In the second event, a worker was following too close to another bicycle and did not allow enough sufficient distance to stop, if there was a problem. The worker simply did not have their mind on the task at hand – inattention.

The cause code is the same for these two events, but the underlying reason, for either choosing a course of action or not, is different. This is not a recurring condition.

Watch List ☐

Recurring ☐

Not Recurring ☒



## Performance Analysis of Events

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2. **Cause Code A5B4C01:** Weapons & Complex Integration, OR 2009-0025 and OR 2009-0036

These two events were reported under different reporting criteria: 1(1) “Operational Emergency,” and 3A(2) “Nuclear Safety Basis, Technical Safety Requirement Violations,” the common cause was identified as A5B4C01, “Communications Less Than Adequate (LTA); Verbal Communications LTA; Communication between work groups LTA.”

In the first event, a roadside vegetation fire was started near the Small Firearms Training Facility (SFTF) at Site 300 in June 2009. It was most likely caused by a burning object ejected from a passing vehicle, as this area of Site 300 is very close to a public road. This code was applied to a problem identified with the response to the fire by those required to make off-site notifications (unable to communicate with the worker via mobile phone or pager), and not listed as a causal factor for the fire itself.

In the second event, communication errors led a worker to select the wrong shutoff valve for a device. The device’s operating and gas-flowing characteristics were assumed to be of one nature, but were actually of another. It was determined that the shutoff valve would not be capable of meeting its safety function, which resulted in a TSR violation.

The main causes of these events are different, and do not represent a recurring condition.

Watch List ☐

Recurring ☐

Not Recurring ☒

The cause codes for the occurrences listed above are listed in Table 14, below.

## Performance Analysis of Events

**Table 14 - Occurrences with the Same Cause Code by Principle Directorate**

Cause Code	Principle Directorate	OR Number	Cat Date	RC	Title	Cause(s)
A3B1C03	DO	2009-0014	3/12/09	2A(6)	Worker Fractures Ankle After Stepping Off Paved Path Near Building 271	Mental lapse – carrying box, vision obstructed, did not have “eyes on path”
		2009-0022	5/13/09	2A(6)	Worker Sustains Ankle Fracture After Slipping Off Curb While Entering Vehicle In Parking Lot	Mental lapse – chose to walk on uneven walking surface
	S&T	2009-0028	2/26/09	2A(1)	On Site Vehicle Accident by Building 242 Results in Fatality	Mental lapse – diverted attention from safely operating vehicle to solving another problem
		2009-0031	9/28/09	2A(6)	Worker Sustains Fracture After Losing Control of Laboratory Bicycle	Mental lapse – inattention to surroundings created hazard
A5B4C01	WCI	2009-0025	6/12/09	1(1)	Operational Emergency Not Needing Further Classification - Roadside Vegetation Fire At Site 300	Not identified as a cause for the event – this cause was listed as a cause for another problem which merely surfaced during the conduct of the emergency operational response
		2009-0036	10/28/09	3A(2)	Hydrogen Excess Flow Shutoff Valve TSR Violation in Building 332	Communication error – wrong item selected due to assumption of required characteristics

# Occurrence Performance Analysis

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## 5.0 Watch List

### Watch List items remaining from the previous report:

There was one Below-ORPS reporting criteria group on the “Watch List” in the previous report.

1. Below-ORPS Group 5A,”Unauthorized or accidental releases (reported to state and local agencies by EPD) that do not meet ORPS reportable criteria.”

There were eight Below-ORPS environmental events that involved water leaks, spills, etc. from failed components or weakening infrastructure. This is an increase of three from the previous report. It was determined, however, that the impact to the environment was not considered to be of concern.

The Facilities & Infrastructure directorate, in conjunction with others knowledgeable of the events, has undertaken the task of analyzing these events for common cause. The analysis has not yet been completed. This below-ORPS group will remain on the watch list, and the results of the analysis will be included in the following report.



Remain on Watch List



Remove from Watch List

### Watch list items to be added for this report:

Two new areas of concern are being placed on the Watch List for this report. Like the item above, they are below-ORPS reportable groups:

- 1) Group 2A “Personal safety”
- 2) Group 4C “Facility status”

# Occurrence Performance Analysis

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## 6.0 Special Reports Review

In this section, we discuss counterfeit electronic devices and their introduction into LLNL work.

### **LLNL Occurrence LLNL-2010-0002**

On January 20, 2010, an employee, working on a Physical and Life Sciences directorate-funded project at the Building 174 complex, was constructing an electronic device using recently purchased transistors. Upon discovering that the transistors were not holding off the specified voltage, the individual tested 15 additional transistors from the same batch purchased by LLNL. Only two of these 15 met published specifications. The employee then tested the same model and make of transistor which was purchased previously from a previous vendor, and all passed. To verify that there were problems with a separate batch of transistors purchased from the new vendor, he performed additional testing on 11 transistors to be used in a separate project. These also failed at approximately the same rate (only two out of 11 passed).

Upon closer inspection of the transistors, it appears that the model number on the back of the transistors had been modified (the type and spacing of the numbers is different from the same model and make purchased from the previous supplier). The testing of the suspect transistors indicated that they performed at a level consistent with a less expensive, lower rated transistor.

This event was reported to the DOE in OR # LLNL-2010-0002, "Suspect/Counterfeit Transistors Discovered in the Building 174 Complex." This event was categorized under Group 4C(2), "Discovery of any suspect/counterfeit item or material other than office supplies, office equipment, or household products," Significance Category 4. A SC 4 report is not required to have a causal analysis or corrective actions documented in ORPS, however, immediate actions and corrective actions were implemented for this event by the directorate involved (S&T, P&LS).

### **US Department of Commerce Report**

In January 2010, the US Department of Commerce, Bureau of Industrial and Security, Office of Technology Evaluation, issued a report on counterfeit electronics procurement and use in the Department of Defense (DOD), entitled, "Defense Industrial Base Assessment: Counterfeit Electronics." It was reported that the DOD suspected an increasing number of counterfeit/defective electronics were infiltrating the supply chain and affecting weapon system reliability.

The purpose of the Office of Technology Evaluation study was to evaluate and to provide statistics on the extent of the problem in the DOD, provide an understanding of the practices that contribute to the problem and identify best practices and recommendations.

A total of 387 companies and organizations, representing all segments of the DOD supply chain participated in the study. It was determined that 39% of the companies surveyed had encountered counterfeit electronics during a four-year period. And, the trend was increasing.

# Occurrence Performance Analysis

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The report listed the following weaknesses and findings:

The rise of counterfeit parts in the supply chain is exacerbated by demonstrated weaknesses in:

- Inventory management
- Procurement procedures
- Recordkeeping
- Reporting practices
- Inspection
- Testing protocols
- Communication within and across all industry and government organizations.

Findings:

- All elements of the supply chain have been directly impacted by counterfeit electronics;
- There is a lack of dialogue between all organizations in the U.S. supply chain;
- Companies and organizations assume that others in the supply chain are testing parts;
- Lack of traceability in the supply chain is commonplace;
- There is an insufficient chain of accountability within organizations;
- Recordkeeping on counterfeit incidents by organizations is very limited;
- Most organizations do not know who to contact in the U.S. Government regarding counterfeit parts;
- Stricter testing protocols and quality control practices for inventories are required; and
- Most DOD organizations do not have policies in place to prevent counterfeit parts from infiltrating their supply chain.

Based on the findings, the following recommendations were made in the report:

- Consider establishing a centralized federal reporting mechanism for collecting information on suspected/confirmed counterfeit parts for use by industry and all federal agencies;
- Modify Federal Acquisition Regulations (FAR), including Defense Federal Acquisition Regulations (DFAR), to allow for “best value” procurement, as well as require U.S. Government suppliers and federal agencies to systematically report counterfeit electronic parts to the national federal reporting mechanism;
- Issue clear, unambiguous legal guidance to industry and U.S. federal agencies with respect to civil and criminal liabilities, reporting and handling requirements, and points of contact in the Federal Bureau of Investigation regarding suspected/confirmed counterfeit parts;
- Establish federal guidance for the destruction, recycling, and/or disposal of electronic systems and parts sold and consumed in the United States;
- Establish a dialogue with law enforcement agencies on the potential need to increase prosecution of counterfeiters and those entities knowingly distributing counterfeit electronic parts;

# Occurrence Performance Analysis

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- Consider establishing a government data repository of electronic parts information and for disseminating best practices to limit the infiltration of counterfeits into supply chains;
- Develop international agreements covering information sharing, supply chain integrity, border inspection of electronic parts shipped to and from their countries, related law enforcement cooperation, and standards for inspecting suspected/confirmed counterfeits; address funding and parts acquisition planning issues within DOD and industries associated with the procurement of obsolete parts.

## **The findings and recommendation from the report are valid, and LLNL should be concerned**

The contents of the US Department of Commerce report were presented to the LLNL assurance managers on February 3, 2010. The purpose of the presentation was to highlight the report findings in relation to the recent occurrence that LLNL experienced with counterfeit transistors, discussed above.

A discussion followed the presentation, and focused on the following:

- Thoroughly review procurement criteria and requirements for devices
- Aggressive assessment of procured electronic parts and assemblies
- Identification and timely reporting of defective, suspect and counterfeit parts and assemblies
- Timely dissemination of information via other means such as lessons learned, DOE collection data sheet process, etc.
- Ensure information dissemination to other federal agencies

It was generally agreed that LLNL work could be impacted in the same fashion as the DOD has been, and that constant vigilance for this problem is required.

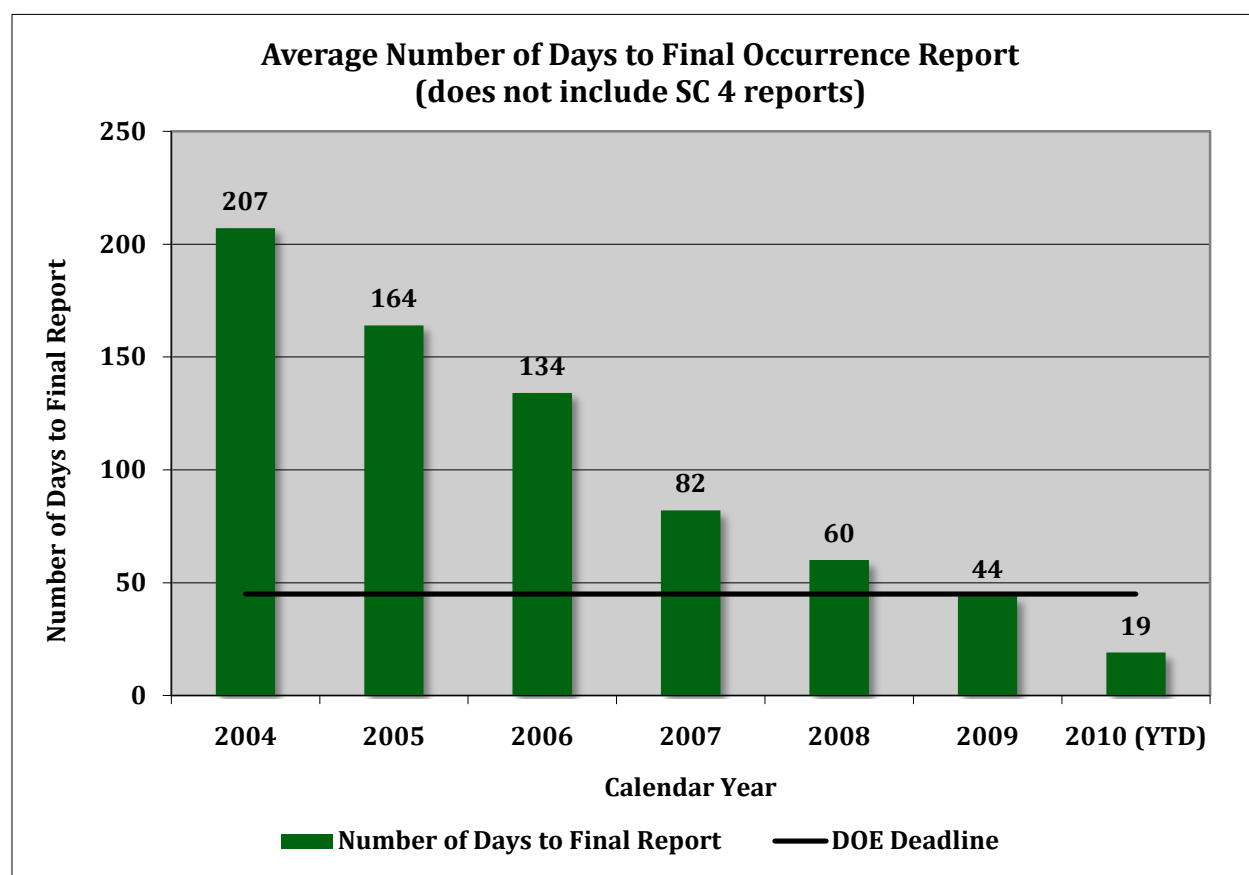
# Occurrence Performance Analysis

## 7.0 Timeliness of Reporting

LLNL has shown continued improvement in its on-time reporting performance through March 2010.

As shown in Figure 16, below, *Average Number of Days to Final Occurrence Report*, the average number of days to finalize an occurrence report in CY08 was 60 days, compared to 82 days in CY07. The average for CY09 is 44 days (the first time that LLNL has averaged less than the DOE-required 45-days), a substantial improvement. This improvement was achieved without a loss of quality of the reports. For CY10, through March 2010, the average number of days to finalize occurrence reports is 19 days, well below the previous yearly averages.

**Figure 16 - Average Days to Final Occurrence Report**



# Occurrence Performance Analysis

## Occurrences Reported after the data was pulled and prior to completion of this report

There have been 17 events reported to ORPS from 1 January through 31 March 2010. These events are listed in Table 15, below:

**Table 15 – Occurrences Reported to ORPS from 1 January through 31 March 2010.**

Report Number	Subject / Title	RC	SC
NA--LSO-LLNL-LLNL-2010-0001	Defective DOT Steel Drum Closure Ring	4C(3)	4
NA--LSO-LLNL-LLNL-2010-0002	Suspect/Counterfeit Transistors Discovered in the Building 174 Complex	4C(2)	4
NA--LSO-LLNL-LLNL-2010-0003	LED Lighting Improperly Marked as UL Listed in Building 332	4C(2)	4
NA--LSO-LLNL-LLNL-2010-0004	Machining of Legacy Part Leads to Indeterminate Beryllium Exposure of Machinist	2A(5)	3
NA--LSO-LLNL-LLNL-2010-0005	Energy Savings Performance Contract (ESPC) Electrical Deficiency Management Concern	10(2)	4
NA--LSO-LLNL-LLNL-2010-0006	Energized Electrical Conductor Cut Without Energy Isolation in Building 391	2C(2)	3
NA--LSO-LLNL-LLNL-2010-0007	Deep Vein Thrombosis Resulting in Hospitalization After Business Travel	2A(6)	3
NA--LSO-LLNL-LLNL-2010-0008	LLNL Employee Dosimeter with Indications of High Exposure	10(2)	4
NA--LSO-LLNL-LLNL-2010-0009	Unexpected Rolling Truck Near Miss	10(3)	3
NA--LSO-LLNL-LLNL-2010-0010	Personal Air Monitoring Sample Above ACGIH TLV For Silica Dust in Building 581	2A(5)	3
NA--LSO-LLNL-LLNL-2010-0011	Work Control Process Management Concern	10(2)	4
NA--LSO-LLNL-LLNL-2010-0012	Alpha Survey Meters Sent Offsite for Repair Returned Due to Contamination	10(2)	3
NA--LSO-LLNL-LLNL-2010-0013	Worker Sustains Lower Leg Fracture After Falling From Bicycle Near Building 142	2A(6)	3
NA--LSO-LLNL-LLNL-2010-0014	Management Concern - Actuation of Building 332 Legacy Alarm System	10(2)	4
NA--LSO-LLNL-LLNL-2010-0015	Building 332 Safety Basis Violation Relative to Functional Testing of the Mobile Weapons Platform	3A(3)	3
NA--LSO-LLNL-LLNL-2010-0016	Unexpected Discharge of Flammable Gas While Drilling Into Gas Cylinder With a Hand Drill	2C(2)	3
NA--LSO-LLNL-LLNL-2010-0017	Certified Unified Program Agency (CUPA) Inspection Notice Of Violation At Site 300	9(2)	4

As of 1 April, 2010, there were nine occurrences that are considered open or “in-progress.” These reports are listed as follows:

1. OR # LLNL-2010-0004 (S&T) Open for 48 days [this report is now considered late in ORPS]
2. OR # LLNL-2010-0006 (NIF) Open for 41 days
3. OR # LLNL-2010-0007 (NIF) Open for 38 days
4. OR # LLNL-2010-0009 (O&B) Open for 35 days
5. OR # LLNL-2010-0010 (NIF) Open for 28 days
6. OR # LLNL-2010-0012 (DO) Open for 28 days



## Occurrence Performance Analysis

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7. OR # LLNL-2010-0015 (WCI) Open for 3 days
8. OR # LLNL-2010-0016 (O&B) Open for 1 day
9. OR # LLNL-2010-0017 (WCI) Open for 1 day

One report, LLNL-2010-0004, has been open for 48 days, three days past the DOE limit of 45-days. This event is the subject of a root cause analysis. It is recognized that root cause analyses typically take longer than 45-days to complete.

These nine events were compared to the events analyzed in this report and those that show some initial commonality of causes with previous events will be analyzed further. The results of this analysis will be included in the following report.

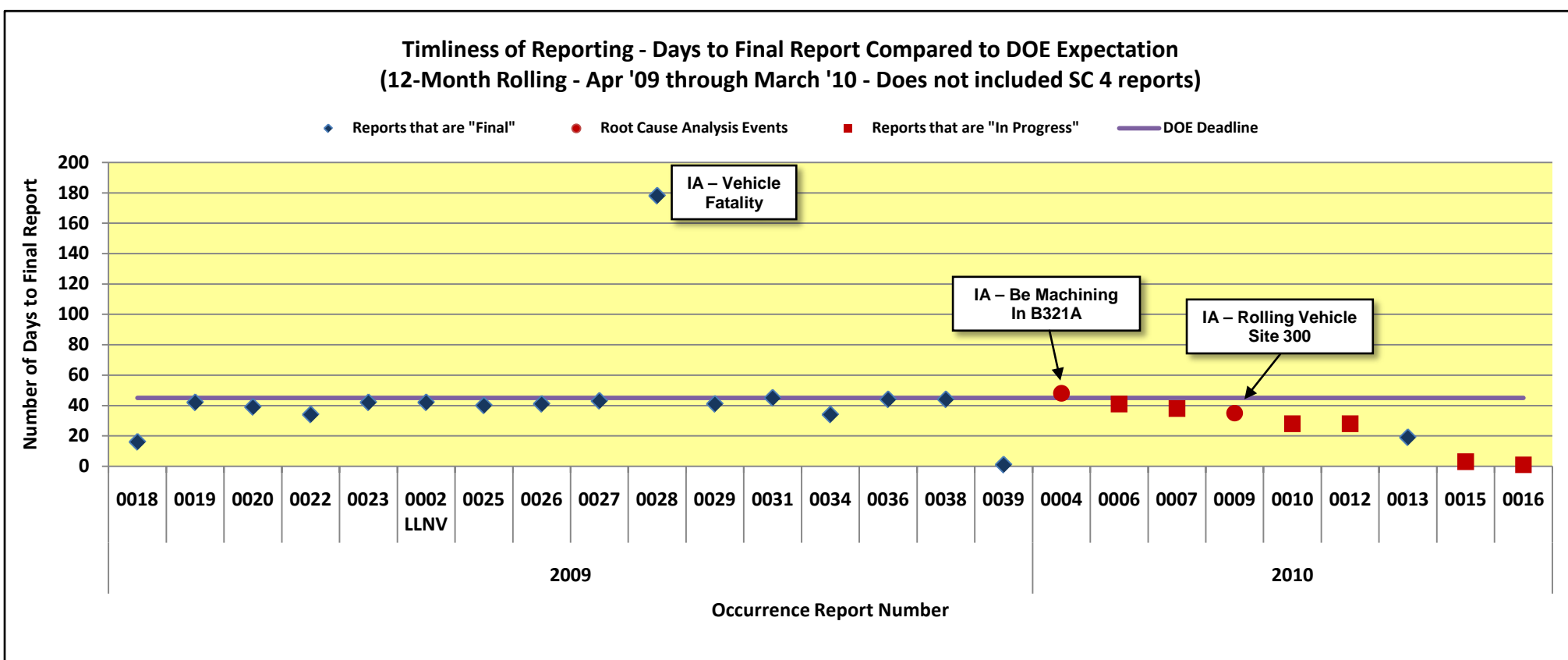
As stated earlier, one event, OR # LLNL-2010-0009, “Unexpected Rolling Truck Near Miss,” shows similar causes to the vehicle fatality event in June 2009 (LLNL-2009-0028). Because of these similarities, an occurrence report will be filed for unsafe vehicle operations recurring at LLNL. The specific details of the analysis and recurring occurrence report will be included in the next report.

# Occurrence Performance Analysis

With the exception of one occurrence (the fatality), all 2009 final ORs were entered into ORPS at or under the DOE deadline of 45 days. For CY10, as of 1 March, there has been one report (machining of legacy part in B321A) that has exceeded the 45-day requirement.

Figure 17, below, depicts 25 LLNL & LLNV occurrences categorized from Apr 1, 2009 through Mar 31, 2010, excluding Significance Category 4 reports (SC 4 reports are considered “final” when they are initially entered into ORPS). Round data points represent occurrences that are the subject of a root cause analysis - It is recognized that root cause analyses typically take longer than 45 days to complete.

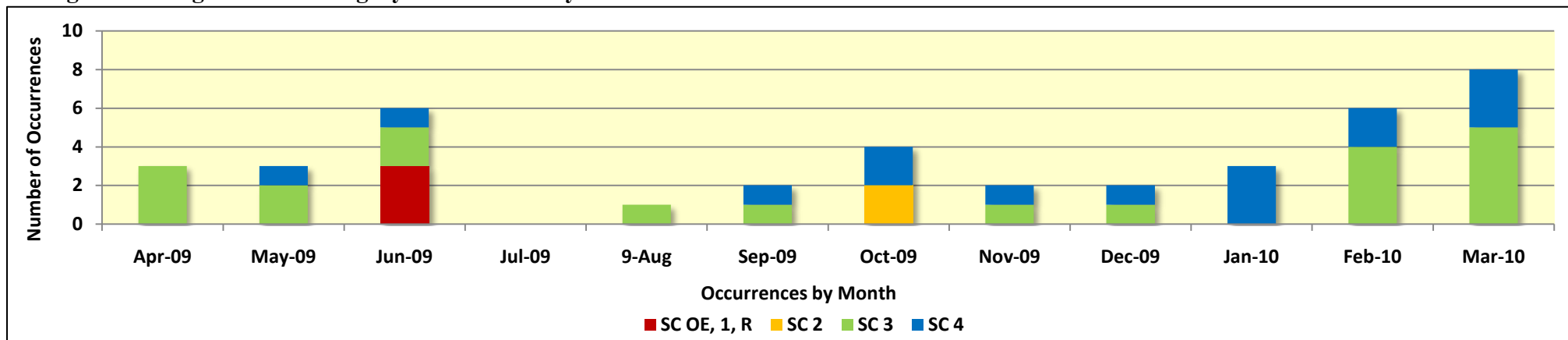
**Figure 17 - LLNL & LLNV ORPS Reporting Performance as of 1 March 2010**



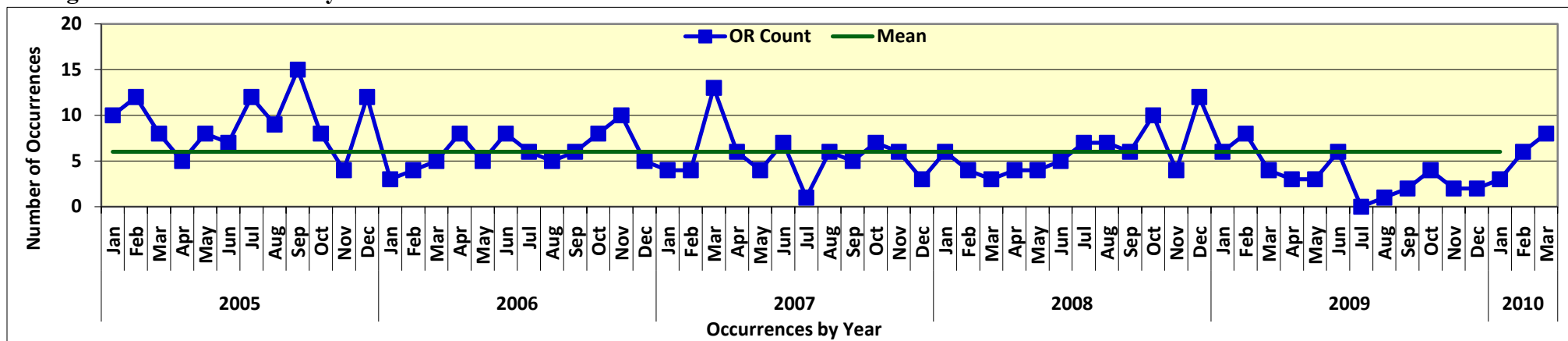
## Occurrence Performance Analysis

In Figure 17, below, occurrences are displayed by Significance Category for CY09. Figure 18 (below) shows the number of occurrences, by year and month, since January 2005. The data shows that in CY09 LLNL experienced a decrease in the total number of reportable events, compared to previous years. The rate of reportable events in 2009 (41) was well below the 5-year LLNL average of the previous four years ('05 – '08) of 80. The first three months of CY10 have shown an increase trend in reporting

**Figure 17 – Significance Category Occurrences by Month**



**Figure 18 – Occurrences by Year and Month Since 2005**



# Occurrence Performance Analysis

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## 8.0 Conclusions

The purpose of occurrence reporting is to provide notification of events or conditions to LLNL management and within the DOE complex so that hazards can be eliminated and occurrences do not recur. The number of total occurrences reported by LLNL during the period analyzed in this report is significantly less than past reports – 41 in CY09, 59 in the previous report, and 76 in the report before that. A decrease in reporting during CY09 was seen in the last six months of the year, but the decrease did not continue into 2010. Starting in October 2009, an increase in reporting brought the event average back to normal levels.

The type of occurrences reported during this review period is similar to past years, and indicate that management is taking actions to report events properly. The timeliness of reporting continues to improve. As of the date of this report, the average number of days to finalize reports in CY2010 is 19 days. There is one open report that is past the DOE deadline of 45-days – the machining of a beryllium part in B321A, and is the subject of a root cause analysis.

There were two Operational Emergencies and one fatality reported in this review period (these events were analyzed in the previous report).

The analysis indicates a recurring condition relative to unsafe vehicle operations, stemming from the June 2009 vehicle fatality and the February 2010 rolling truck near miss. The causal analysis for the rolling truck event was completed on March 25, 2010, with corrective actions forthcoming, too late for inclusion in this report. The corrective actions identified for this recurring condition will be included in the next report.

One area of concern remains on the previous report's Watch List (Group 5, "Environmental"), and two new groups have been added (Group 2A "Personal Safety," and Group 4C "Violations of Procedures").

Concerning frequency of reporting, all LLNL Principle Directorates reported occurrences during this review period. All directorates, with the exception of Global Security, showed a decrease in the number of events reported compared to the last report period. Global Security stayed the same with two events (the least reported by any directorate). The distribution of the number of occurrences by principle directorate is similar to the previous analysis, with only slight variations: The Directors Office had four occurrences in this period, two less than in the previous reporting period. Global Security had two occurrences, the same as the previous report. The National Ignition Facility & Photon Science showed a slight decrease in events this period, with seven, compared to eight in the previous period. The Operations and Business principle directorate showed a decrease in events from 10 to seven for this period. Science and Technology decreased markedly from 17 to nine occurrences. The Weapons and Complex Integration showed a decrease from 16 to 12 occurrences for this period.

Overall, the number of events reported during this period has declined significantly, from 59 events in the previous period to 41 for CY09. This decrease will be monitored for its significance for the next report.

## **Occurrence Performance Analysis**

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This report analyzed many events that were also analyzed and reported in the previous report. The variability between the number of events of a particular reporting criteria from the previous report is not significant.

Overall, we analyzed 41 ORPS-reported occurrences and numerous below-ORPS events during this review period. The analysis of the areas of concern (Watch List items) will be included in the next report.

## References

Montgomery, Douglas C. (1997), *The Introduction to Statistical Quality Control* (John Wiley & Sons, Inc., New York, NY).

# Occurrence Performance Analysis

## Appendix A - List of Reported Occurrences

**This appendix lists all of the Occurrence Reports issued by LLNL for CY09;  
and for 1 January through 31 March 2010**

**RC=Reporting Criteria      SC=Significance Category**

Occurrences from 1 January to 31 December 2009			
Report Number	Subject / Title	RC	SC
NA--LSO-LLNL-LLNL-2009-0001	Centers for Disease Control and Animal and Plant Health Inspection Service Inspection Results for Bio Facilities	9(2)	4
NA--LSO-LLNL-LLNL-2009-0002	Suspect Bolts Identified on Ratchet Tie Down Straps in Building B6199C	4C(2)	4
NA--LSO-LLNL-LLNL-2009-0003	Legacy Beryllium Contamination Discovered Inside Toolbox In Building 321A	10(2c)	3
NA--LSO-LLNL-LLNL-2009-0004	Building 298 Yard Bead Blaster Unit Footprint Contamination	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0005	Items Labeled "Contains Beryllium" Improperly Disposed	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0006	Unauthorized Work On Lighting Switch In Building 453 Office	2C(2)	3
NA--LSO-LLNL-LLNL-2009-0007	Suspect/Counterfeit Rigging Shackle Found in Building 121	4C(2)	4
NA--LSO-LLNL-LLNL-2009-0008	Building 801 Momentary Entry Into Contained Firing Facility Chamber Without Respirator Filter	10(2c)	3
NA--LSO-LLNL-LLNL-2009-0009	Copper Conductor Left In Electrical Cabinet Causes Short in Building 117	10(2c)	3
NA--LSO-LLNL-LLNL-2009-0010	NIF Target Positioner Nose Cone Pivoted, Pinning Worker's Hand	10(3c)	3
NA--LSO-LLNL-LLNL-2009-0011	Beryllium Contamination Found in Newly Commissioned Bead Blaster in Building 298	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0012	Worker Struck on Head by Unexpected Closure of Roof Hatch Cover in Trailer 1677	10(2c)	3
NA--LSO-LLNL-LLNL-2009-0013	110-Volt Power Line Severed During Concrete Cutting Activity in Building 481	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0014	Worker Fractures Ankle After Stepping Off Paved Path Near Building 271	2A(6)	3
NA--LSO-LLNL-LLNL-2009-0015	Arcing Tabletop Laser in Building 179	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0016	HEPA Filters Purchased for Installation in Building 332 Rejected	4C(3)	4
NA--LSO-LLNL-LLNL-2009-0017	LLNL Flatbed Truck Accident with DOE Rental Car	10(3c)	3
NA--LSO-LLNL-LLNL-2009-0018	Management Concern over Building 695 Operations	10(2c)	3
NA--LSO-LLNL-LLNL-2009-0019	Near Miss Involving Non-authorized Energized Work in Building 691	2C(2)	3
NA--LSO-LLNL-LLNL-2009-0020	On-Site Procedures Not Followed in Movement of Radiological Material	10(2c)	3
NA--LSO-LLNL-LLNL-2009-0021	Management Concern Regarding Material Processing	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0022	Worker Sustains Ankle Fracture After Slipping Off Curb While Entering Vehicle In Parking Lot South of Building 661	2A(6)	3
NA--LSO-LLNL-LLNL-2009-0023	Building 153 Evacuated Due to Toxic Gas Monitoring System Alarm	4B(4)	3
NA--LSO-LLNL-LLNL-2009-0024	Site Landscaping and Event Preparation Management Concern	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0025	Operational Emergency Not Needing Further Classification - Roadside Vegetation Fire At Site 300	1(1)	OE
NA--LSO-LLNL-LLNL-2009-0026	Operational Emergency Not Needing Further Classification - Wildland Fire At Site 300	1(1)	OE
NA--LSO-LLNL-LLNL-2009-0027	Non-Energized Electrical Cable Cut Without Proper Energy Isolation	10(3c)	3
NA--LSO-LLNL-LLNL-2009-0028	On Site Vehicle Accident by Building 242 Results in Fatality	2A(1)	1
NA--LSO-LLNL-LLNL-2009-0029	Discovery of Modified Exterior 2nd Floor Hand Rail System at Building 432	10(3c)	3
NA--LSO-LLNL-LLNL-2009-0030	Discovery of Suspect/Counterfeit Items in Building 132N	4C(2)	4

# Occurrence Performance Analysis

Occurrences from 1 January to 31 December 2009 (cont.)			
Report Number	Subject / Title	RC	SC
NA--LSO-LLNL-LLNL-2009-0031	Worker Sustains Fracture After Losing Control of Laboratory Bicycle	2A(6)	3
NA--LSO-LLNL-LLNL-2009-0033	Spread of Legacy Radioactive Contamination in Building 331	6B(4)	4
NA--LSO-LLNL-LLNL-2009-0034	Worker Receives Electric Shock When Finger Enters Into Broken Light Switch Casing in Building 235 Kitchen	2C(1)	2
NA--LSO-LLNL-LLNL-2009-0035	Improper Disposal of Hazardous Containers in Dumpster at Building 264	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0036	Hydrogen Excess Flow Shutoff Valve TSR Violation in Building 332	3A(2)	2
NA--LSO-LLNL-LLNL-2009-0037	Management Concern - Fire Sprinkler Damaged in Building 581 Causing Water Discharge in Switch Yard 2	10(2d)	4
NA--LSO-LLNL-LLNL-2009-0038	Storage of Accountable Legacy Tritiated Oil in Building 331	3B(1)	2
NA--LSO-LLNL-LLNL-2009-0039	Degradation of a Component in the Building 332 Fire Suppression System	4A(1)	3
NA--LSO-LLNL-LLNL-2009-0040	Building 132N Liquid Nitrogen Fill Station Leak	10(2d)	4
NA--NVSO-LLNV-LLNV-2009-0001	Measurable Radioactive Release to the JASPER Secondary Confinement Chamber Vessel	10(2c)	3
NA--NVSO-LLNV-LLNV-2009-0002	Movement Of Combustible Fuel In Proximity Of Facility Not Analyzed Per Safety Basis	3A(3)	3
Occurrences from 1 January to 31 March 2010			
Report Number	Subject / Title	RC	SC
NA--LSO-LLNL-LLNL-2010-0001	Defective DOT Steel Drum Closure Ring	4C(3)	4
NA--LSO-LLNL-LLNL-2010-0002	Suspect/Counterfeit Transistors Discovered in the Building 174 Complex	4C(2)	4
NA--LSO-LLNL-LLNL-2010-0003	LED Lighting Improperly Marked as UL Listed in Building 332	4C(2)	4
NA--LSO-LLNL-LLNL-2010-0004	Machining of Legacy Part Leads to Indeterminate Beryllium Exposure of Machinist	2A(5)	3
NA--LSO-LLNL-LLNL-2010-0005	Energy Savings Performance Contract (ESPC) Electrical Deficiency Management Concern	10(2d)	4
NA--LSO-LLNL-LLNL-2010-0006	Energized Electrical Conductor Cut Without Energy Isolation in Building 391	2C(2)	3
NA--LSO-LLNL-LLNL-2010-0007	Deep Vein Thrombosis Resulting in Hospitalization After Business Travel	2A(6)	3
NA--LSO-LLNL-LLNL-2010-0008	LLNL Employee Dosimeter with Indications of High Exposure	10(2d)	4
NA--LSO-LLNL-LLNL-2010-0009	Unexpected Rolling Truck Near Miss	10(3c)	3
NA--LSO-LLNL-LLNL-2010-0010	Personal Air Monitoring Sample Above ACGIH TLV For Silica Dust in Building 581	2A(5)	3
NA--LSO-LLNL-LLNL-2010-0011	Work Control Process Management Concern	10(2d)	4
NA--LSO-LLNL-LLNL-2010-0012	Alpha Survey Meters Sent Offsite for Repair Returned Due to Contamination	10(2c)	3
NA--LSO-LLNL-LLNL-2010-0013	Worker Sustains Lower Leg Fracture After Falling From Bicycle Near Building 142	2A(6)	3



# **Occurrence Performance Analysis**

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## **Appendix B – ORPS Reporting Criteria Groups and Subgroups**

### **Group 1 - Operational Emergencies**

### **Group 2 - Personnel Safety and Health**

<b>Subgroup A</b>	<b>Occupational Illnesses/Injuries</b>
<b>Subgroup B</b>	<b>Fires/Explosions</b>
<b>Subgroup C</b>	<b>Hazardous Energy Control/Fires</b>

### **Group 3 - Nuclear Safety Basis**

<b>Subgroup A</b>	<b>Technical Safety Requirement Violations</b>
<b>Subgroup B</b>	<b>Documented Safety Analysis Inadequacies</b>
<b>Subgroup C</b>	<b>Nuclear Criticality Safety</b>

### **Group 4 - Facility Status**

<b>Subgroup A</b>	<b>Safety Structure/System/Component Degradation</b>
<b>Subgroup B</b>	<b>Operations</b>
<b>Subgroup C</b>	<b>Suspect/Counterfeit and Defective Items or Material</b>

### **Group 5 - Environmental**

<b>Subgroup A</b>	<b>Releases</b>
<b>Subgroup B</b>	<b>Ecological and Cultural Resources</b>

### **Group 6 - Contamination/Radiation Control**

<b>Subgroup A</b>	<b>Loss of Control of Radioactive Materials</b>
<b>Subgroup B</b>	<b>Spread of Radioactive</b>
<b>Subgroup C</b>	<b>Radiation Exposure</b>
<b>Subgroup D</b>	<b>Personnel Contamination</b>

### **Group 7 - Nuclear Explosive Safety**

### **Group 8 - Transportation**

### **Group 9 - Noncompliance Notifications**

### **Group 10 - Management Concerns/Issues**

# Occurrence Performance Analysis

## Appendix C – Below-ORPS (Site-reportable) Groups and Subgroups

<b>Group 2 Personal Safety</b>	<p>A. Any single occurrence requiring medical treatment or inpatient hospitalization beyond first aid unless otherwise reported as a near miss. (Note: 29 CFR1904.7(b)(i) and (ii) defined “medical treatment” and “first aid.”)</p> <p>B. Measured exposures that exceed an action level; regardless of PPE used.</p> <p>C. A determination that the prescribed hazardous energy control process was not followed properly and one of the following conditions resulted:</p> <ol style="list-style-type: none"> <li>1. Discovery that additional equipment should have been controlled through the lockout/tagout (LO/TO); even though the equipment was found in a safe state.</li> <li>2. Discovery that any equipment included in the LO/TO was not properly controlled (e.g.; missing or non-effective lock) even though the equipment was found in a safe state.</li> <li>3. A fire that takes less than 10 minutes to put out or (a fire that) disrupts operations in a moderate hazard facility.</li> </ol>
<b>Group 4 Facility Status</b>	<p>A. Performance degradation/actuation of credited safety structures; systems; and components (SSCs) in non-nuclear facilities that prevents satisfactory performance of its design function when it is required to be operable.</p> <p>B. Life Safety equipment (not designed as safety class or safety significant) is inoperable for an extended period of time (more than the time it would take to properly repair).</p> <p>C. Violation of safety controls in facility safety plans (FSPs); Operational Safety Plan (OSPs); or Integration Work Sheets/Safety Plans (IWS/SPs) including without proper authorization.</p>
<b>Group 5 Environment</b>	<p>A. Unauthorized or accidental releases (reported to state &amp; local agencies by EPD) that do not meet ORPS reportable criteria.</p>
<b>Group 6 Radiation</b>	<p>A. Any continuous air monitor (CAM) alarms from breathing air from airborne radioactivity (segregating radon alarms from non-radon event).</p> <p>B. Nasal swipes that exceed 10 dpm TRU combined; from both</p>

## Occurrence Performance Analysis

	nostrils for any single individual.
<b>Group 8 Transportation</b>	<p>A. Any accident involving a vehicle carrying hazardous/radiological material that is not otherwise reportable.</p> <p>B. Any violation of LLNL requirements involving on-site transportation of explosives.</p>